

# **Community in the Classroom Presentation Plan**

**Lesson Name** Measuring the world with Vernier Probes

**Presenter(s)** Derek Vigil Currey, Ph.D student in Physics at UCB

**Grade Level** 4-5    **Standards Connection(s)** molecules, measurement, motors, electricity, circuits, breathing and CO<sub>2</sub>

## **Teaser:**

Learn how you can understand the world around you and within you, i.e. breathing, molecules, light, and electricity, using simple tools called probes

## **Vocabulary/Definitions:**

Probe or sensor: a device that measures something your interested in

generator: something that turns mechanical energy into electricity

respiration: when you breathe in and out, releasing carbon dioxide

force: how much something pushes or pulls

voltage: how much push there is on the charges (electrons) that make up electricity

wavelength: the distance between crest to crest in a wave

## **Materials:**

I will bring:

2 labquests

3 go-links

1 CO<sub>2</sub> probe

5 stainless steel temp probes

1 colorimeter or spectrometer

5 voltage probes

1 soil moisture probe

1 heart rate monitor

1 grip strength tester

soil and a container for soil

1 bouncy frog

5 hand generators

LEDs and christmas lights

cups, salt, ice

digital projector

1 laptop

2 bananas

The students should have pencil or pens, and a notebook to write in (preferably a scientific notebook)

I will need the Vernier force probe, labquest and Go-link that is at the school. The labquest should be charged ahead of time.

## **Classroom Set-up:**

5 groups of students – it would be good if they were all at a clusters of table

The room should be able to be made dark for projection (I will bring a digital projector)



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Set up time should be about 5-10 minutes

Clean-up time should be about 5 minutes as well

It would be good if the room could be set up so the kids could do some jumping jacks to get their heart rates up for when I talk about carbon dioxide and respiration

## **Classroom Visit**

### **1. Personal Introduction: 1 Minutes**

Derek Vigil – Ph. D student at Berkeley in Physics, interested in doing science education and outreach, in addition to my research on materials of technological interest, i.e. for batteries and solar cells.

### **Topic Introduction: 5 Minutes**

I have a question: when someone says it's really bright outside, how do you know if it really is? Or how do you know if it is cold outside or whether some water you have is hot? What about if you see something that you think is blue, but someone else said it was yellow, how could you prove it was purple?

-The only way to know is to measure the given property (temperature, brightness) with a device called a probe

-definition of probe

-show them Vernier probe and turn on graph showing the CO<sub>2</sub> content in the room

-have kids get up and do some jumping jacks to get their heart rate up, watch the CO<sub>2</sub> levels go up

-Ask them why CO<sub>2</sub> levels went up

-definition of respiration

-This also why you get sleepy sometimes in class, or at church, the build-up of CO<sub>2</sub> makes humans sleepy!

### **2. Learning Experience(s): 40-50 Minutes**

Alternate between hands on experiments and activities and demonstrations

Experiment 1: Measuring the freezing temperature of ice as you add salt

1. Students plug the sensors into the go-links and labquests, and turn on the labquests or open Loggerlite if they are on the computer. Tell them to hit the green button to take data. I'll have the labquests and computer set up to take data over the correct interval.
2. Students put ice in a cup and get a separate cup filled with salt
3. Students measure the temperature of ice before and after adding ice
4. Ask the students what happened and if they have any ideas why

Demonstration 1: Measuring the amount of red, green, and blue in different types of lights

1. Ask the student how they could prove to someone that something was a given color?
2. Tell them that light is a wave and it has a wavelength – the distance between peak and trough
3. We can measure this with a sensor
4. Ask students if they've heard that "white light" is made of a mixture of all the colors of the rainbow
5. Ask them if they think different types of lights are made up of different amounts of each color
6. Measure the light output of incandescent, fluorescent, and LED bulbs; show students the difference



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- a) Fluorescent lights are “bluer”, especially the older variety, and in general are sort of an unnatural form of light, hence why some people don't like them

Experiment 2: measuring the voltage output of a battery, a hand generator, a banana battery

1. Ask students if they know how to measure how much electricity something is putting out
  - a) You can measure the voltage (also current, but we won't talk about that)
2. Ask students if they know how many volts a AA puts out
3. Have them measure the voltage
4. Have them check if which way they touch the probe to the battery matters to the sign of the output (it does)
  - a) Electricity has a direction
    - This is why you always hook black to black and red to red when you are jumping a car, because if the two electricities are fighting each other, the batteries can explode
5. What happens when the batteries die? Too low of voltage but not zero! 1.4 doesn't work, often times
6. Have them make their own voltage with the hand generator, ask them if the sign of the voltage depends on which direction you turn the generator
  - a) + and -, just like the battery
7. Time permitting, have them make a banana battery with a copper post, zinc nail and a banana
  - a) There are fruit clocks!

Demonstration 2: Grip strength tester

1. Have students come up and see how strong they can grip the probe
2. Grip it myself
3. Show them that you can measure it
4. You can also measure heart rate and many other biological quantities

Time permitting, give them demonstrations of the force, soil moisture, and heart rate probes

1. Unlikely there will be time for this, but I am well practiced with these probes and can show the kids them easily

### 3. Wrap-up: Sharing Experiences

0 Minutes

N/A. Conversation is had throughout the lesson, so no need to repeat here. My aim is to get them excited about probes and the things they can measure.

### 4. Connections & Close:

4 Minutes

Closing comments: I hope the students learned a lot about science today, but especially about how you can measure things using probes and learn about the world and nature. Science does not just come out of a book but is discovered by smart people like you who are curious enough to go out and test things in the world. Science helps you understand practical things too, like why you should jump your car battery in a certain way. How to make electricity in its modern form was discovered only 150 years ago, which is much less than how long humans have been along! There are many things still left to be discovered, especially if people use tools such as probes to learn more about the world. I hope they will think of me when they go to do science fairs as they get older, or if they want to start experimenting now. I can provide them guidance on using probes and how to design experiments to learn about nature. We have probes that measure heart rate, how dirty water is, how much oxygen there is in water, gas pressure, force, magnetic field, and so much more, so whatever your interest, I'm sure we can find a probe that will help you do an experiment.



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TOTAL 50 – 60 Minutes

## **Follow-up – After Presentation**

Students can feel free to email me at [vigil@berkeley.edu](mailto:vigil@berkeley.edu) and ask me about being a scientist, making measurement, probes, etc.

I recommend Vernier's website ([vernier.com](http://vernier.com)) for more information about the probes that are out there and the experiments that can be done with them



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