Recognizing and Appreciating Science as an Integrated Part of Daily Life: A Case Study of Engaged Student Learning

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Author Biography

Paramasivam Sivapatham Ph.D., is a Professor of Environmental Science at Savannah State University, teaching and conducting research for over two decades. His focus is on environmental health research (soil, plant, water, air and waste management). His scholarly accomplishments include: 15 book chapters, 75 peer reviewed papers, 75 conference paper presentations and 12 invited presentations. He has served as a Co-PI, CORE Leader, and Collaborating faculty in NIH and NSF funded grant programs. He is also Co-PI of one of the NSF Grants (PRISM) availing funds for developing Discovery Learning Laboratory at Savannah State University to teach Science to non-science majors.

Introduction

As one who teaches Integrated Science to non-science majors, I use the very simple definition of science, namely, "the state of knowing: knowledge as distinguished from ignorance or misunderstanding." It is therefore neither strange nor surprising, even in the olden days, the contents of science have always been incorporated to some extent in the school curriculum. With the recent explosion in science and technology and the extraordinary power it has given us to impact the environment and human health (sometimes adversely) combined with the proliferation of the specialized disciplines under the STEM umbrella, the higher education sector has the obligation to encourage the majority non-science students to dwell deeper into science - the State of Knowing! This implies that every faculty has to ensure that every non-science major student gets interested in science.

At Savannah State University, I teach Integrated Science (ISCI), a core course designed for students who have chosen to major in disciplines which are generally called non-science majors. At the start of the course, most of these students consider themselves to have an acute dislike for mathematics and science. They lack interest and wonder why they should take this Integrated Science course. Though, for me, an experienced professor in teaching, in the beginning this posed a challenge because it is not just teaching - business as usual! I had to design a curriculum and syllabus incorporating appropriate subject matter picked out from the ocean of science material, to deliver it appropriately (lectures, demonstration, lab experiments, field visits, current news, etc.), and most of all to engage the students (a class of about thirty-five students and three such sections) so that, if not right at the beginning, at least by mid-term, they will not only appreciate its importance but love SCIENCE!

Goal of the Activity

My goal is to make sure all the discovery learning activities developed for this course meet the objectives of engaged learning through ensuring their active participation, critical thinking, as well as visual and analytical skills while learning the subject with interest and appreciation. Generally, every semester, I conduct a minimum of six discovery learning activities along with video presentations and lectures to cover this course. The discovery learning activity described in this manuscript represents the collective team work each student who is personally responsible for recording measurements in time and then submit the computation and final report in the next class meeting.

Activity Description - Radiation Measurement

This involves measuring background radiation and radiation from standard Alpha, Beta and Gamma radiation-producing samples in the presence / absence of various calibrated absorber shields. We are

constantly exposed to a wide variety of radiation like cosmic rays, soils, and from other materials. In this experiment, the students measure the background radiation by Geiger Muller Counter. Measured sample activity must be corrected by subtracting the background counts. Radiation is a random event that could be minimized / prevented using appropriate shield material.

Apparatus
SPECTECH ST 360 G-M Tube, Counter and calibrated absorber shields

Sources
Alpha (**α**) source:

a. Po-0.1 μ Ci, Half-life 138.4 days

Beta (**β**) source:

a. Sr-90 0.1 μ Ci, Half-life 28.8 years,
b. Ti-204 1.0 μ Ci, Half-life 3.78 years

Gamma (**γ**) source:

a. Co-60, 1.0 μ Ci, Half-life 5.27 years.

Presentation of Observation and Results
Observations and calculations are presented in a Table Format shown below.

Selected Student feedback

This lab helped me to become more conscious of how much I expose myself to [radiation].

It was an eye opening lab to learn about radiation and how it affects the world & us as humans.

Our radiation lab was very interesting. I know that I am probably exposed to radiation in some form as a Radio Personality from equipment used in Mass Communication.

I found this lab to be very informative and learned something new being that I am a business major.

Conclusions

The feedback from students reveal that the students enjoyed their engagement in the rigorous learning process used in this discovery learning radiation measurement lab, and it helped them to learn new information that could affect their life. Even though almost all the students in this class are non-science majors, the best practices (processes) used in the implementation of this discovery learning model made them to be more comfortable to understand the high-tech science (one faces in everyday life) in a very simple way. It also taught students punctuality, time management and submission of lab reports in a professional style. Looking back, the interest the non-science major students developed in science, their performance and their feedback confirm Winston Churchill's words "Continuous effort - not strength or intelligence - is the key to unlocking our potential."

Table 8: Results for Integrated Science II – SPRING 2020 – Discovery Exercise 1

Lab Date: Jan 27, 2020 Report Due Date: Jan 28, 2020

Type of Radiation	Sources	Absorber Shield Used	Radiation [COUNTS PER 10 SECONDS]			Average Radiation (CPM) = [(Average of R1+R2+R3/3) x 6] [CPM = COUNTS PER MINUTES]	Average Net Radiation Activity (CPM) [Avg Radiation-Avg Background]
			Run-1	Run-2	Run-3		
None	Background		3	7	3	=[((3+7+3)/3)x6] = 26	= 26
Alpha (α)	Po	None	7	5	6	=[((7+5+6)/3)x6] = 36	=(36-26) = 10
		B	3	8	6	=[((3+8+6))/3)x6] = 34	=(34-26) = 08
		D	7	5	5	=[((7+5+5))/3)x6] = 34	=(34-26) = 08
		F	5	9	11	=[((5+9+11)/3)x6] = 50	=(50-26) = 24
		P	4	7	6	=[((4+7+6))/3)x6] = 34	=(34-26) = 08
		S	3	6	11	=[((3+6+11)/3)x6] = 40	=(40-26) = 14
Beta (β)	Sr	None					
		B					
		D					
		F					
		P					
		S					
	Ti	None					
		B					
		D					
		F					
		P					
		S					
Gamma (ϒ)	Co	None					
		B					
		D					
		F					
		P					
		S					

Description of Absorber Shields

B *[1 Mil Al Foil – 6.5 mg cm²]*; **D** *[8 Mil Poly – 19.2 mg cm2];* **F** *[0.040 Plastic –1021 mg cm²];* **P** *[0.125 Al –840 mg cm²];* **S** [0.125 Pb –3448 mg cm²]

Students Engaged in Discovery Learning Radiation Measurement Laboratory