# Additions to the nuclear scalar lab

**Summation of Materials**

Geiger-Muller tube (nuclear scaler)

Radioactive sources for alpha particles, beta particles, and gamma radiation

Forceps

Various shielding materials as provided by the instructor

**For the extra extensions of the lab:**

•250 mL Beaker

•Ring Stand

•3-Prong Clamp

•Empty paint can

•pH probes

•Soil, rock, sand, etc.

•Plastic jewelry baggies

PART D. CAN WE DETECT RADIATION IN CELL PHONES?

1. Set the counter interval to 0.5 minutes.

2. Place a cell phone in the tube.

3. Run three different tests to test for ionizing radiation from your cell phone. First with the phone

 simply on, then with the phone receiving a text, and lastly with the phone receiving a call.

Question D-1. What are current forms of ionizing radiation that we receive in our lives? How do

 we protect ourselves against them?

Question D-2. From your data, what conclusions can you make concerning the amount of ionizing

 radiation that the cell phone put out?

Question D-3. What do, or should, phone manufacturers take into account when designing these

 cell phones in terms of limiting the amount of ionizing radiation?

PART G. SHIELDING NUCLEAR WASTE

1. After fuel is spent inside of a nuclear reactor it must be stored temporarily. This is done by

 placing the spent fuel in pools of water.

2. We will test how deep the pools need to be to safely protect against ionizing radiation from spent fuel.

3. Attach the Geiger-Muller tube to a ring stand with a 3-prong clamp. It must be just tall enough to be able to house the 250 mL beaker.

4. Place the gamma source directly underneath the G-M tube. Take 3 counts with a time interval of 30 seconds.

5. Next place the 250 mL beaker over the gamma source. Again, take 3 counts.

6. Then add 1 cm. of water to the beaker. Take 3 counts.

7. Continue adding 1 cm. of water and taking 3 counts up to 8 cm. of water.

Question G-1. Make a graph of distance of shielding versus counts per half-minute.

Question G-2. Draw a best-fit line. The minimum depth that the fuel is placed at is 8 ft.

(they are placed much deeper than this though). Using your data, at a depth of 8 ft. how much (in a percent) would the water reduce the original activity of the fuel?

**EXTENSION ON THIS ASPECT AND IDEAS:**

1. This lab is very long. Could be done as a regular chemistry class doing parts A-F. Then part G (with all of its extensions coming after) can be done in another class at a department’s discretion (I will be using that part in my environmental science class for instance).
2. Students could also test the water in and of itself after prolonged exposure to radiation samples. This leads to the connection of what happened at Fukushima and how there were worries about the water supply being contaminated.
3. Students could also check to see if ionizing-radiation leads to a pH change in the water. Thus providing a wonderful opportunity to see just how the ecology changes as a result.
4. Could also use things other than water. Ideas thrown out were soil, rock, sand.
5. Also spoke about using a paint can and how well it shields. Students could then design their own nuclear containment container and run with it. Explain their reasoning, have a competition with the entire class, etc.
6. After data is collected talk about local nuclear power plants (Illinois), where the New Madrid fault line is located, its activity in the past. Students could provide a report on possibility for H2O contamination due to nuclear power, earthquakes, accidents, etc.
7. Based on results, would you live next to a power plant, what should we do as a country regarding the expansion of nuclear power, etc.

PART E. THE EFFECT OF DISTANCE ON THE AMOUNT OF EXPOSURE TO RADIATION

|  |  |  |
| --- | --- | --- |
|  Shelf Position |  Distance From Source |  Count |
|  2nd From Top |  2 cm |  |
|  3rd From Top |  3 cm |  |
|  4th From Top |  4 cm |  |
|  5th From Top |  5 cm |  |
|  Bottom |  6 cm |  |

Question E-1. From your data, why is it preferable to build a nuclear power plant in a sparsely populated area rather than close to a big city?

PART G: THE EFFECT OF DEPTH ON THE AMOUNT OF EXPOSURE TO RADIATION

|  |  |
| --- | --- |
|  DEPTH |  Count |
|  0 cm of H2O |  |
|  1 cm of H2O |  |
|  2 cm of H2O |  |
|  3 cm of H2O |  |
|  4 cm of H2O |  |
|  5 cm of H2O |  |
|  6 cm of H2O |  |
|  7 cm of H2O |  |
|  8 cm of H2O |  |

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