

**Signal Strength Lab**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Class: \_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_**

**Subject Ms. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

***Problem***

How can you represent the relationship between an electromagnetic signal and distance/location?

***Hypothesis***

What do you think will happen?

Write your hypothesis in the “If…(independent variable), then…(dependent variable)” format?

IV-Distance

DV-Signal strength

If \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

then \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Materials***

* Transmission devices:
  + Baby monitors, electronic car key, radio control cars, wireless microphone or walkie talkies.
* COSMOS collection Database
* SDR receiver (500 hz -1.7 Ghz)
* Measuring tool (ribbons cut into 1.5 m or 15 meters long)
* Laptops
* Post-it Chart Paper
* Chair to hold the COSMOS toolkit in place
* Markers
* Graph Paper
* Graphic Organizer to record data
* Vocabulary Sheet for the students

***Procedure***

**Pre-lab preparations (Must be done prior to part A and part B)**

1. In your group, decide which job each person will have
   1. Walkie-Talkie 1 Signal Transmitter: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Walkie-Talkie 2 /Signal Receiver: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. Timer: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   4. Data Recorder/Program Runner: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   5. Facilitator/Overseer of the whole Experiment
2. Set up COSMOS data collection program.
   1. Make sure that you have two walkie-talkies per group.
   2. Each group will be assigned at different frequencies.
   3. Make sure that both persons holding the walkie-talkie are on the same channel at your designated group.
   4. Check if the SDR receiver is attached to your computer and to your antenna.
   5. Download the 1-4-walkie-talkie- constellation.grc to have the program running in your computer.
   6. Test if the program is running and make sure your group should be link to a specific radio frequency different from other groups.
   7. Your group should consist only of 5 people.
   8. Each person in the group will have to take the responsibility of the task assigned to them.
   9. The overseer is in-charge of making sure that everyone in the group is on task and that the whole experiment is done correctly.
   10. You’re all responsible to take care of the COSMOS Toolkit.
3. Discuss how you will orchestrate the whole process or create a system where you can perform the whole process within the allotted time.
4. Wait for your teacher’s instructions before starting the experiment.

**Part A- Outside (example in a schoolyard, park or open field)**

1. Each group can choose a spot on the playground/park far from other teams, where you wanted to perform the experiment.
2. Put your COSMOS toolkit on a flat surface/top of the chair.
3. Stand at the starting point, this will be your zero meter.
4. Timer should start the clock as the transmitter starts moving. This experiment should be done in 30 minutes.
5. The transmitter should travel along a straight path, moving 5 meters away (about 16-17 feet) for every stop.
6. The transmitter push the button of the walkie-talkie for every stop and communicates with the receiver on the walkie-talkie to record the data.
7. The recorder looks at the screen and write down the signal strength seen from the computer screen.
8. Repeat steps 9-11 until the the transmitter reaches 50 meters.

**Part B-Indoors (Receiver in classroom, transmitter in hallway)**

**DOOR CLOSED:**

1. Complete steps 1-4 in “Pre-lab Preparations”
2. All receivers for each team stay in the classroom and choose a specific corner/spot in the room to set up the COSMOS toolkit in place.
3. Wait for your teacher to give you permission to go into the hallway if you are the transmitters.
4. Stand at the starting point, this will be your zero meter.
5. Timer should start the clock as the transmitter starts moving. This experiment should be done in 30 minutes.
6. The transmitter should travel along a straight path (if the hallway is a 50 meter stretch) moving 5 meters away (about 16-17 feet) for every stop. Otherwise, indicate in your data collection the shape of your school’s hallway (example U-shape, an L -shape, etc.) coz this will show different results of the experiment.
7. The transmitter push the button of the walkie-talkie for every stop and communicates with the receiver on the walkie-talkie to record the data.
8. The recorder looks at the screen and write down the signal strength seen from the computer screen.
9. Repeat steps 6-8 until the the transmitter reaches 50 meters.

**DOOR OPEN:**

1. Find out the results of the same experiment with the door open in another period/session.
2. Repeat steps 1-8.

***Data Collection Sheets:***

**Part A-Signal Strength Outdoors**

|  |  |
| --- | --- |
| Distance in Meters | Signal Strength in Db |
| 0 |  |
| 5 |  |
| 10 |  |
| 15 |  |
| 20 |  |
| 25 |  |
| 30 |  |
| 35 |  |
| 40 |  |
| 45 |  |
| 50 |  |

**Part B-Signal Strength Indoors**

|  |  |
| --- | --- |
| Distance in Meters | Signal Strength in Db |
| 0 |  |
| 5 |  |
| 10 |  |
| 15 |  |
| 20 |  |
| 25 |  |
| 30 |  |
| 35 |  |
| 40 |  |
| 45 |  |
| 50 |  |

Guide Questions:

1. What have you noticed from the data gathered in A? How is the signal strength affected as the transmitter moves away every 5 meters?
2. Compute for the percentage of change in the signal (whether it’s an increase or decrease) as the transmitter moves away every 5 meters.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Distance**  **(in meters)** | **Signal Strength** | **Percentage (Decrease or Increase)** | **Fractional**  **(Decrease or Increase)** | **Decimal**  **(Decrease or Increase)** |
| 0-5 | -16.92 dB to -17.47dB |  |  |  |
| 5-10 |  |  |  |  |
| 10-15 |  |  |  |  |
| 15-20 |  |  |  |  |
| 20-25 |  |  |  |  |
| 25-30 |  |  |  |  |
| 30-35 |  |  |  |  |
| 35-40 |  |  |  |  |
| 40-45 |  |  |  |  |
| 45-50 |  |  |  |  |

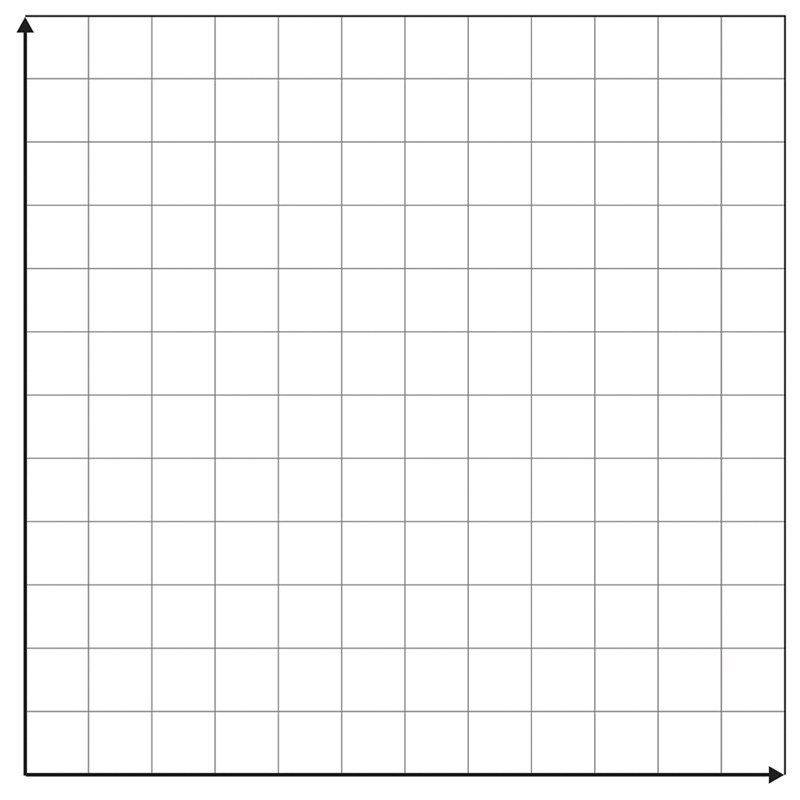
1. What have you noticed from the data gathered in B? How is the signal strength affected as the transmitter moves away every 5 meters?
2. Repeat step 2.
3. Did you notice any significant difference? Why or why not?
4. How does your data look like if you plot these points on a Cartesian Plane?

***Analysis/Conclusions***

Using the data that you collected in part A and part B of your experiment, create a graph to plot the points from your own table and make some observations.

Remember to give your graph a title, and to label the X-axis and the Y-axis.

Part A-Graph



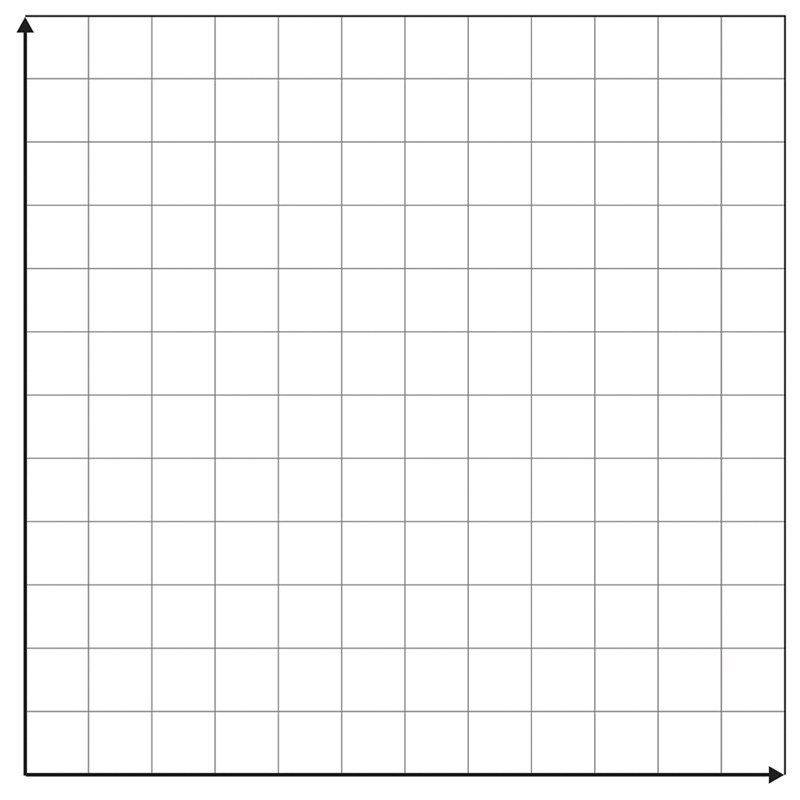
Questions:

1. What did you notice about your Graph A?
2. Is the slope between each pair of points a constant ratio? Why or why not?

Justify your thinking and show your work.

1. What could be some factors affecting this phenomenon? Explain probable reasons.
2. Based on you graphical data, what can you conclude about the relationship between distance and signal strength?
3. Explain why the graph does not show a straight line.

Part B-Graph



Questions:

1. What did you notice about your Graph B?
2. Is the slope between each pair of points a constant ratio? Why or why not?

Justify your thinking and show your work.

1. What could be some factors affecting this phenomenon? Explain probable reasons.
2. Based on you graphical data, what can you conclude about the relationship between distance and signal strength?
3. Explain why the graph does not show a straight line.

**Reflections**

1. **Post your responses to these questions on Google Classroom.**
2. **Everyone is encourage to respond to each other by answering each other’s questions or sharing your observations.**

**RULES:**

**Use the data/facts gathered from experiments as basis of your discussion.**

Think about your experiment!!

Your discussion must be detailed and include answers to the following questions:

* How did your data from part A and part B the same?
* How is the data from part A and part B different?
* What are some factors that could’ve led to differences between the two parts?
* Do you feel the data is valid (reliable and accurate)? Why or Why not?
* What were the sources of error in this experiment (factors that may have affected your results)? Explain.
* If you had the opportunity to redo the experiment, what changes would you make? How would you improve it? Explain.
* What new questions did the experiment generate? Explain.
* What did you learn from the experiment? Explain.

**EXTENSIONS for PROJECTS:**

1. Investigate the results of the same experiment but done in:
2. Lunch room during lunch periods where there are 200-300 people present.
3. In a hallway of a Mall

B. Project:

1. Perform the same experiment using different transmission devices such as wireless microphone, Baby monitors, electronic car key, radio control cars/toys
2. Record the data in the same format as the walkie-talkie.

C. Create a powerpoint presentation of the different results and make