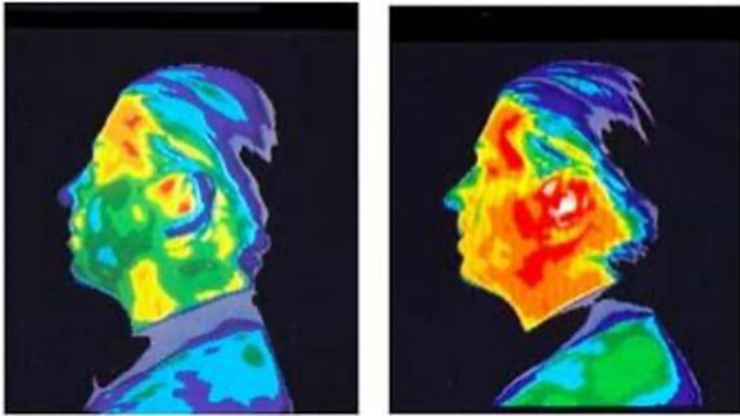


Measuring Cell Phone Electromagnetic Radiation

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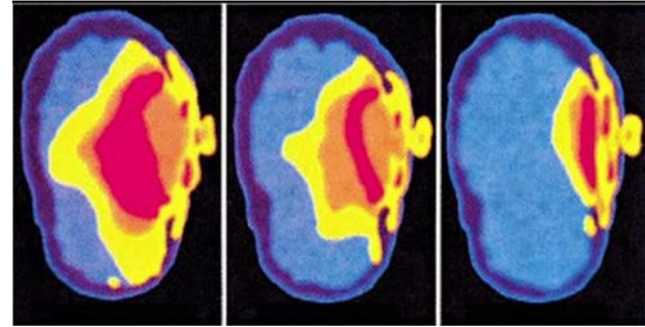
Project Rationale

Cell phones emit electromagnetic radiation that could be hazardous to your health. Research has shown that adults and children should be cautious of how far they hold their phones to their body because it could cause a long-term cancer such as brain cancer.



BEFORE

AFTER



5 year old

10 year old

Adult

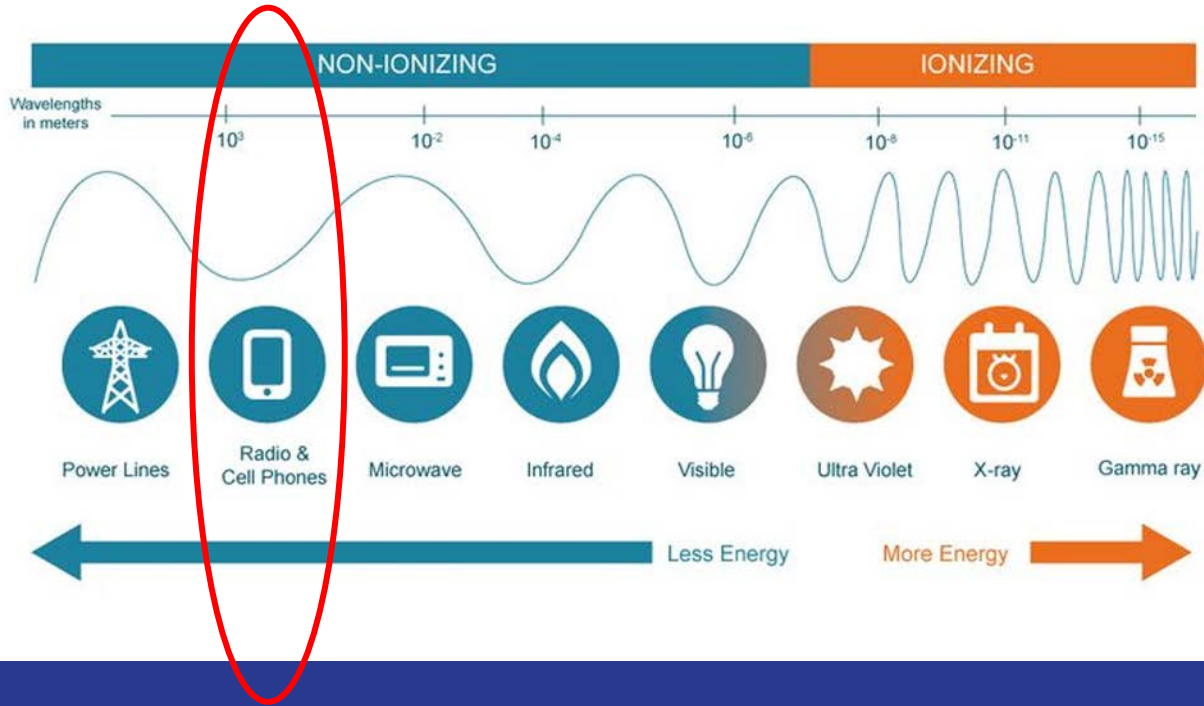
Research Questions

1. How much radiation does a cell phone emit when making a phone call, making a text, and when watching YouTube?
2. How does the amount of radiation change with distance?



Background

Cell phones emit radiofrequency (RF) radiation from their antennas in the form of non-ionizing (low frequency) radio waves.



Background

Radiofrequency (RF) meters measure electromagnetic radiation from many different devices, such as cell phones, that transmit at radio wave frequencies.

The Average Power ($\mu\text{W}/\text{m}^2$) will be used to measure the radiation since signals are transmitted in bursts or pulses and an average changes less, so the reading will be more accurate.



Hypothesis

If the type of phone usage has an effect on the amount of electromagnetic radiation emitted from a cell phone, then using apps, like YouTube, on a cell phone will emit a greater frequency of radiation than other tasks like calling or texting does.



Variables

Dependent:

- Radio waves

Independent:

- Distance (2cm, 5cm, 15cm)
- Phone usage (call, text, YouTube)

Control:

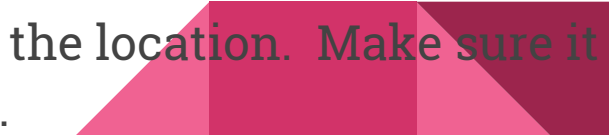
- Measurement of background RF

Constants:

- Radio frequency meter
- Location of testing
- Phone (iPhone 11 Pro)
- Person called and texted
- YouTube video

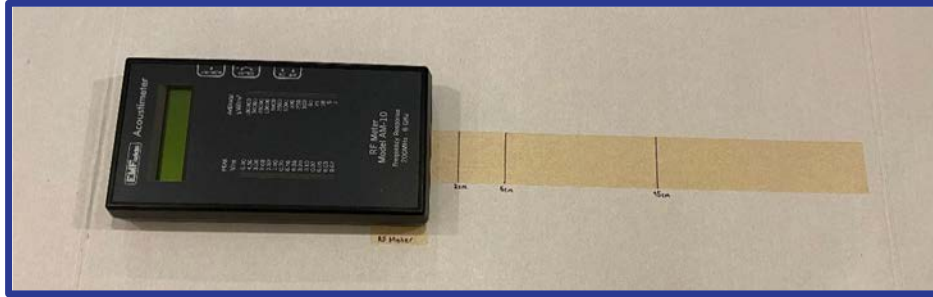


Procedure

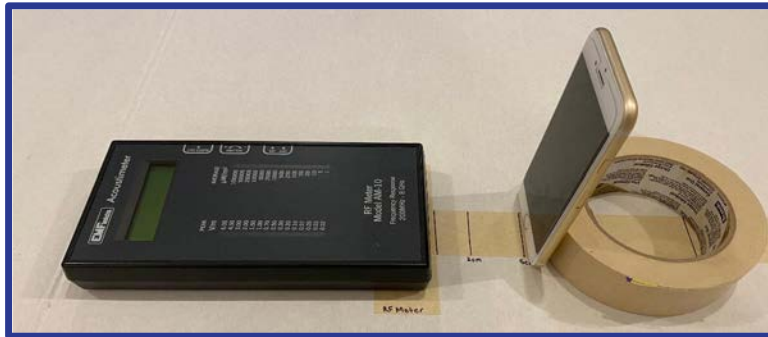
1. Gather materials:
 - RF meter
 - Cell phone
 - Phone stand
 - Ruler
 2. Turn off all known sources of radio waves (WIFI, cell phones, tablets, computers).
 3. Set up Radio Frequency (RF) Meter.
 4. Measure the background radio frequency level of the location. Make sure it is as low as possible with little to no interference.
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Procedure continued


5. Measure and mark locations at 2cm, 5cm, and 15 cm from the RF meter.



6. Select 1 cell phone and place it facing the RF meter at the 2cm mark.



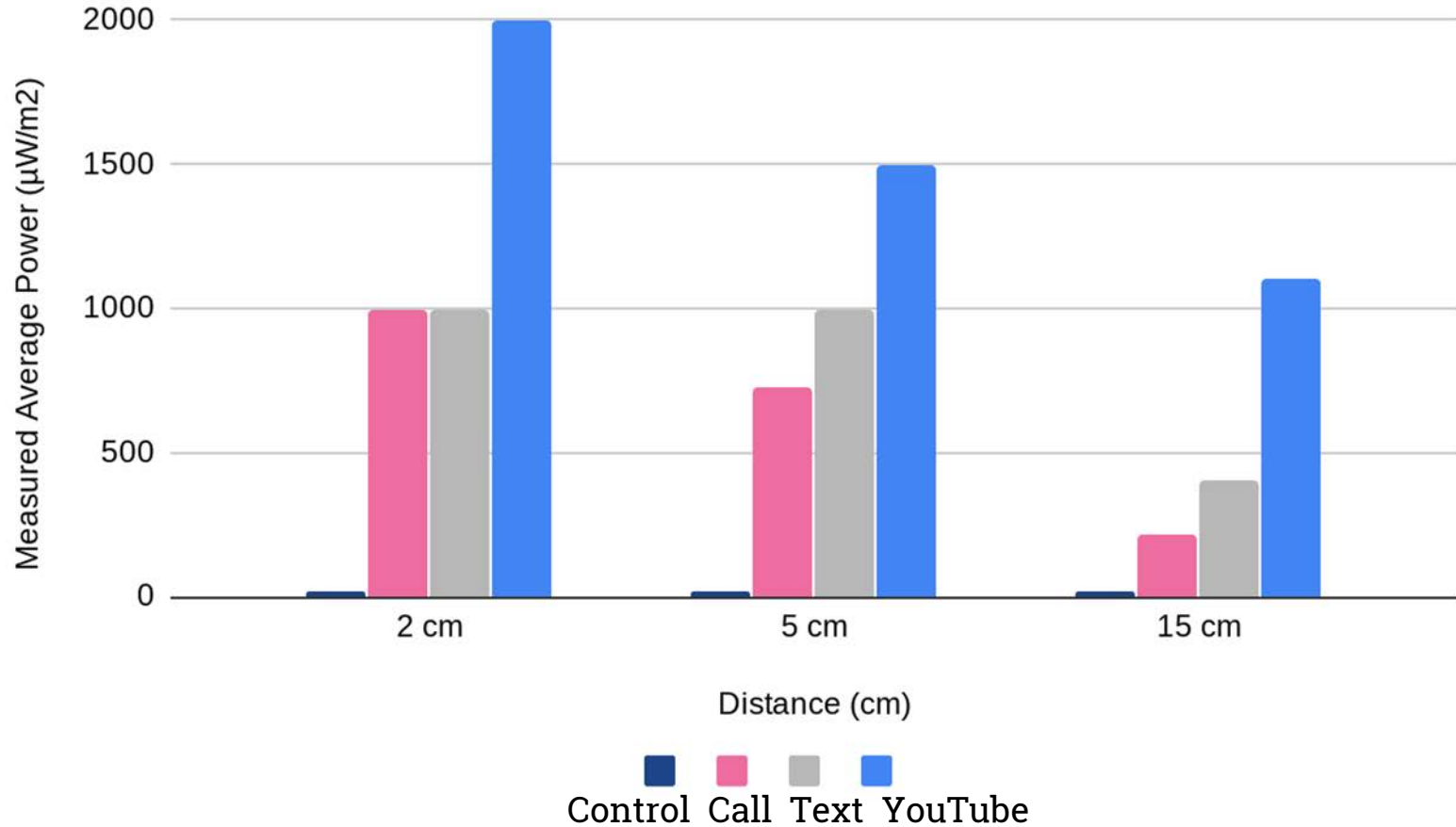
Procedure continued

7. Make a call on the cell phone and take an average measurement from the RF meter.
 8. Record the $\mu\text{W}/\text{m}^2$ and end the call.
 9. Repeat steps 3-5 using the same cell phone, testing at the 5cm and 15cm distances.
 10. Use the same procedures, but while texting.
 11. Use the same procedures, but while watching a YouTube video.
 12. Record results.
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iPhone 11 Usage Data

iPhone 11 Use:	Background radiation (control)	Call	Text	YouTube
2 cm	$<1 \mu\text{W}/\text{m}^2$	$1000 \mu\text{W}/\text{m}^2$	$1000 \mu\text{W}/\text{m}^2$	$2000 \mu\text{W}/\text{m}^2$
5 cm	$<1 \mu\text{W}/\text{m}^2$	$730 \mu\text{W}/\text{m}^2$	$1000 \mu\text{W}/\text{m}^2$	$1500 \mu\text{W}/\text{m}^2$
15 cm	$<1 \mu\text{W}/\text{m}^2$	$220 \mu\text{W}/\text{m}^2$	$400 \mu\text{W}/\text{m}^2$	$1100 \mu\text{W}/\text{m}^2$

iPhone 11 Use (Call, Text, YouTube)



Conclusion

If the type of phone usage has an effect on the amount of electromagnetic radiation emitted from a cell phone, then using apps, like YouTube, on a cell phone will emit a greater frequency of radiation than other tasks like calling or texting does.


I accept this hypothesis because using applications, like YouTube, had electromagnetic frequency measurements of $2000 \mu\text{W}/\text{m}^2$ when compared to the others cell phone usages, which had measurements of $1000 \mu\text{W}/\text{m}^2$. I infer this could be because applications, like YouTube, consume more energy.

Possible Errors

- Outside interference such as neighbors WIFI or phone transmissions and sibling movement in the house.
- The 2cm readings may not have been as accurate as the 5cm and 15cm readings because it was so close to the meter and could have caused interference in the readings.



Future Research

- Compare other models and types of cell phones to see how much radiation they emit.
 - Compare radiation measurements using cellular tower signals versus WIFI signals.
 - Check other sources of radiation such as microwaves, computers, bluetooth headphones, etc.
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Bibliography

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