Cell Phone Radiation Effects on Cancer

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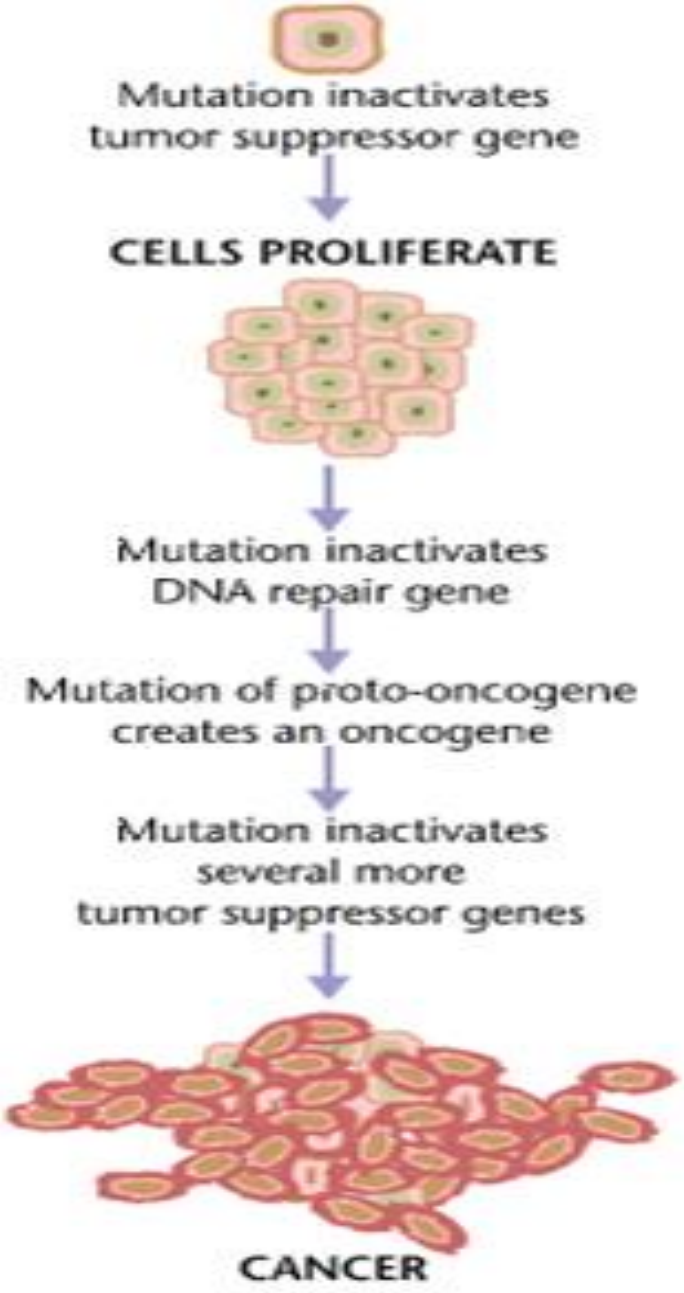
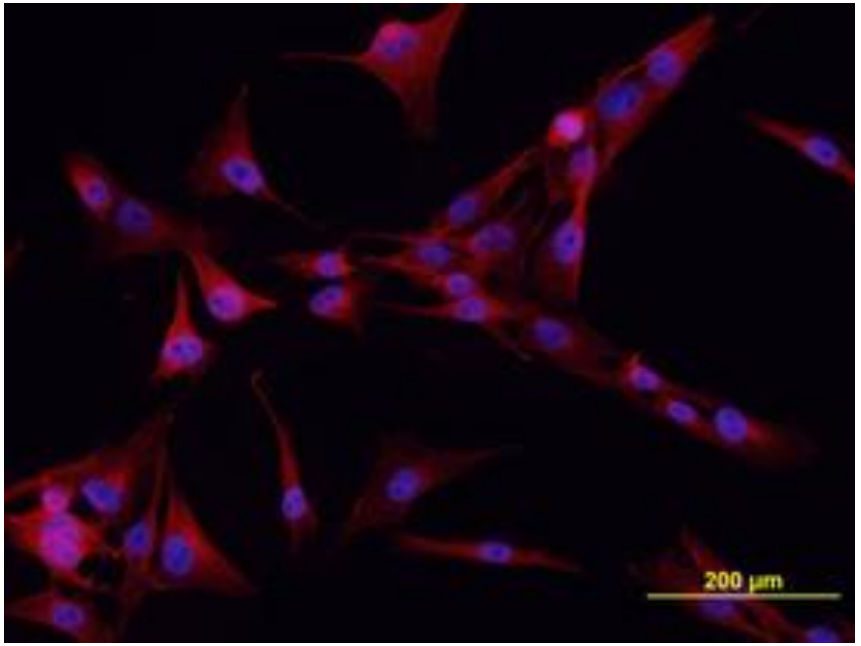
Cancer Overview

- Cancer cells are cells that grow and divide at an irregular, unregulated pace.
- Apoptosis does not occur in cancerous cells; their mutations are passed on to the second generation, eventually clustering and forming tumors.
- Tumors can be malignant (aggressive) or benign.



MG63 Cell Line

- Human cancer cell line
- *Osteosarcoma* cells, an aggressive form of bone cancer
- Useful model to test the effects of variables on cancer cell proliferation



Cell Phones and Radiation

- Cell phones are accessible to about 6 billion of the 7 billion people in the world today.
- Cell phones emit radiofrequency energy, a form of electromagnetic radiation, which can be absorbed by tissues closest to where the phone is held.
- To measure radiofrequency energy from cell phones, the Specific Absorption Rate (SAR) is used, a measure of the amount of radio frequency energy absorbed by the body when using the handset.
- The average SAR used in this experiment was 1.1 while the FCC requires an SAR below 1.6.

Cell Phones and Cancer

- Studies thus far have not shown a consistent link between cell phone use and cancers of the brain, nerves, or other tissues of the head or neck.

Purpose

- To determine the effect of cell phone radiation on cancer cell proliferation.

Hypotheses

Null Hypothesis

- Cell phone radiation **WILL NOT** have a significant effect on cancer cell proliferation.

Alternative Hypothesis

- Cell phone radiation **WILL** have a significant effect on cancer cell proliferation.

Materials

- Cryotank
- Three 75mm² tissue culture treated flasks
- Twelve 25 mm² tissue culture treated flasks
- Fetal bovine serum (FBS)
- MG63 Osteosarcoma Cancer Cell Line
- Macropipette + sterile macropipette tips (1 mL, 5 mL, 10, mL, 20 mL)
- Micropipettes + sterile tips
- DMEM Serum - 1% and Complete Media (4 mM L-glutamine, 4500 mg/L glucose, 1 mM sodium pyruvate, and 1500 mg/L sodium bicarbonate + [10% fetal bovine serum for complete])
- Two Cell Phones
- 75 mL culture flask
- Incubator
- Nikon Inverted Microscope
- 24 well plate
- Laminar Flow Hood
- Laminar Flow Hood UV Sterilizing Lamp
- Labeling Tape
- Hemocytometer
- Sterile PBS
- Ethanol (70% and 100%)
- Purple Nitrile gloves
- Trypsin-EDTA
- Pen/strep

Cell Culturing Procedure

- A 1 mL aliquot of MG63 cells from a Cryotank was used to inoculate 30 mL of 10% serum DMEM media in four 75mm² culture flask yielding a cell density of approximately 10^6 to $2x10^6$ cells.
- The media was replaced with 15 mL of fresh media to remove cryo-freezing fluid and incubated (37° C, 5% CO_2) for 2 days until a cell density of approximately $4x10^6$ to $5x10^6$ cells/mL was reached.
- The culture was passed into two sets of 3 flasks in preparation for experiment and incubated for 2 days at 37° C, 5% CO_2.

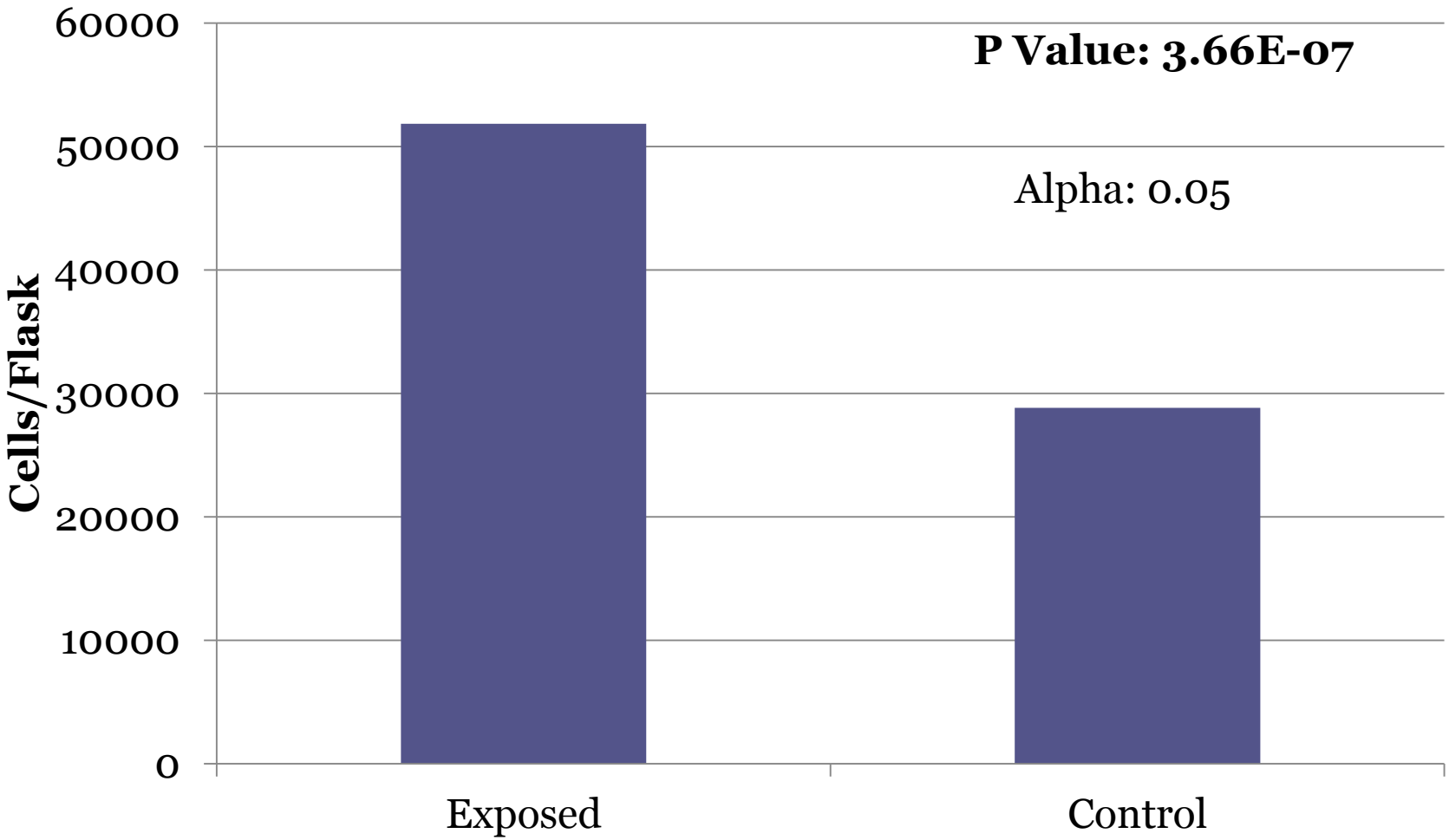
Procedure

- After trypsinization, cells from all of the flasks were pooled into 1 common 75mm² flask (cell density of approximately 1 million cells/mL).
- 1.5 mL of the cell suspension was added to 25 mm² tissue culture treated flasks containing 3.5 mL of DMEM (com) media, creating a cell density of approximately 3 x 10^4 cells per flask.
- Experimental flasks were exposed to cell phones and incubated. (12 replicates)
  - Three flasks were placed on each cell phone.
- The cells were incubated at 37°C, 5% CO_2 for the remainder of the study.

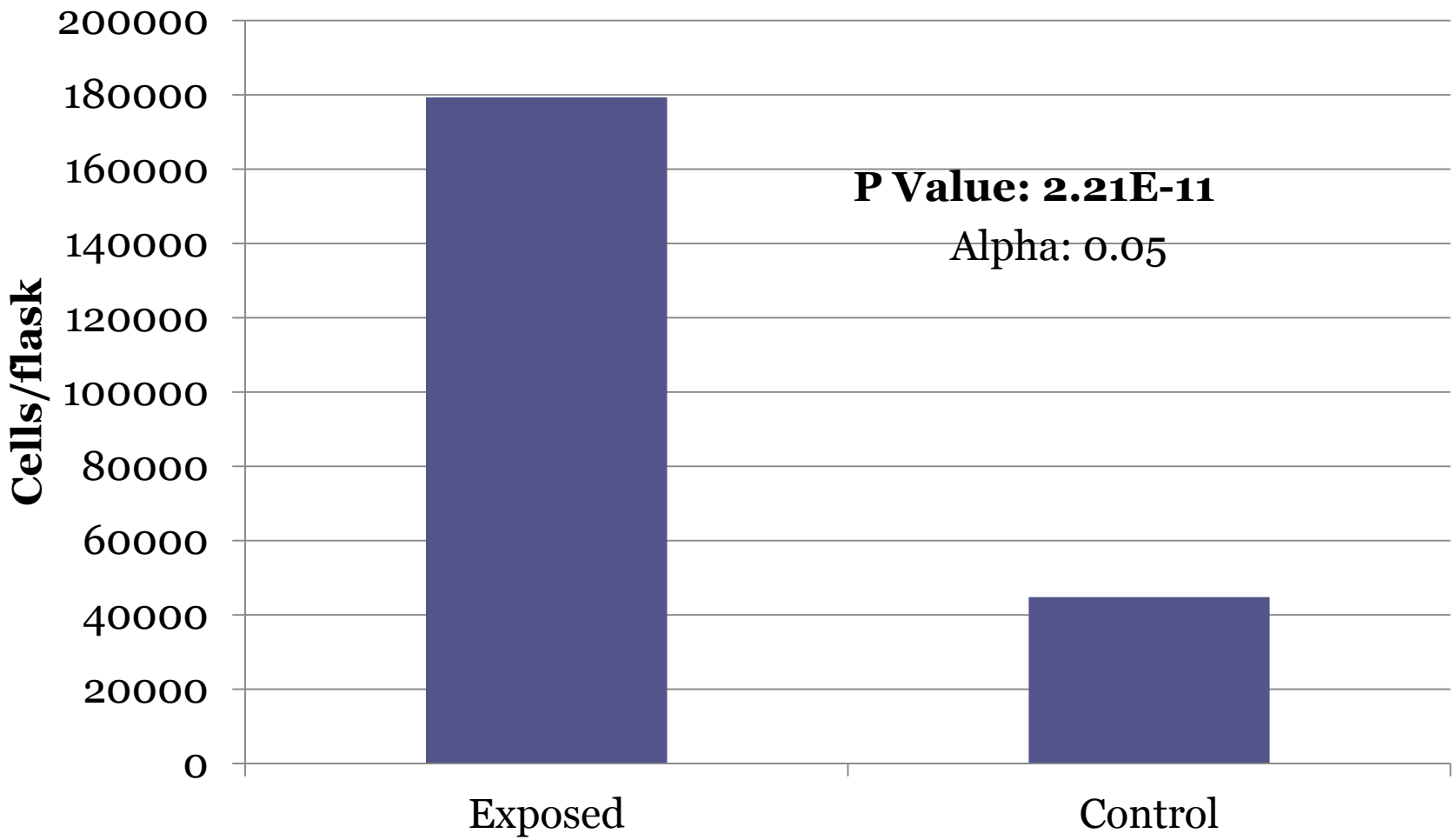
Procedure: Determining Cell Densities

- Day 1 and Day 3
  - For each flask, cell densities were determined as follows:
    - The cells were trypsinized and collected into cell suspension.
    - 25 µl aliquots were transferred to a Hemocytometer for quantification (eight counts per flask).
    - Cells were incubated between Day 1 and Day 3.

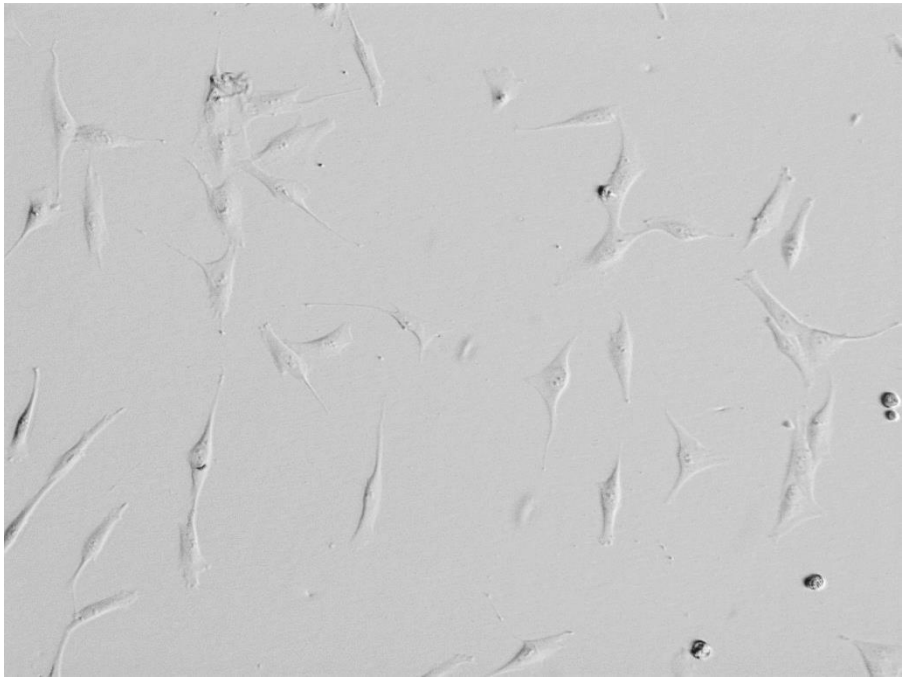
Cell Phone Exposure on MG63: Day 1



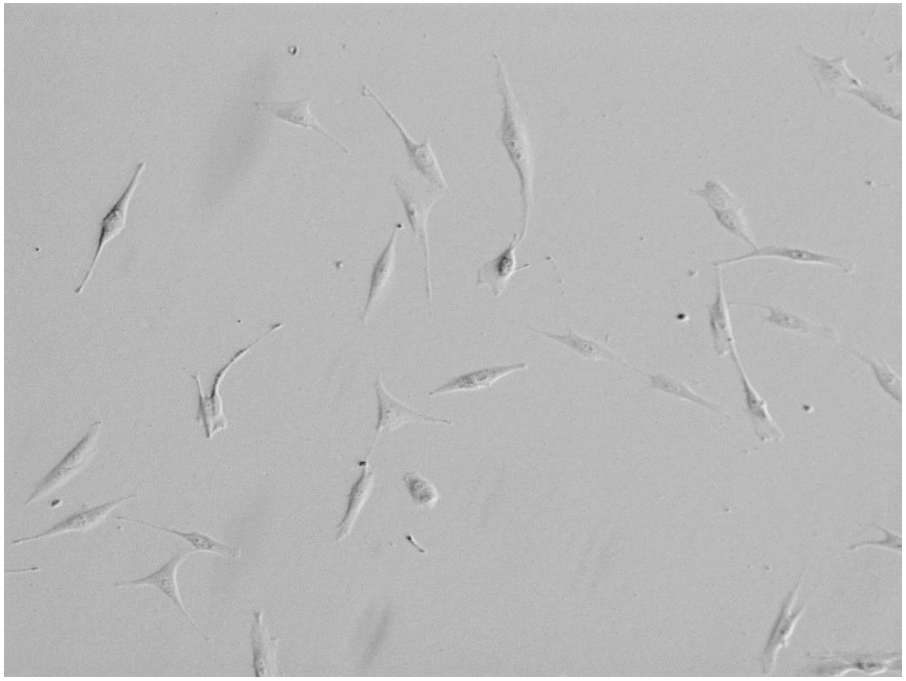
Cell Phone Exposure on MG63: Day 3



Images: Day 1

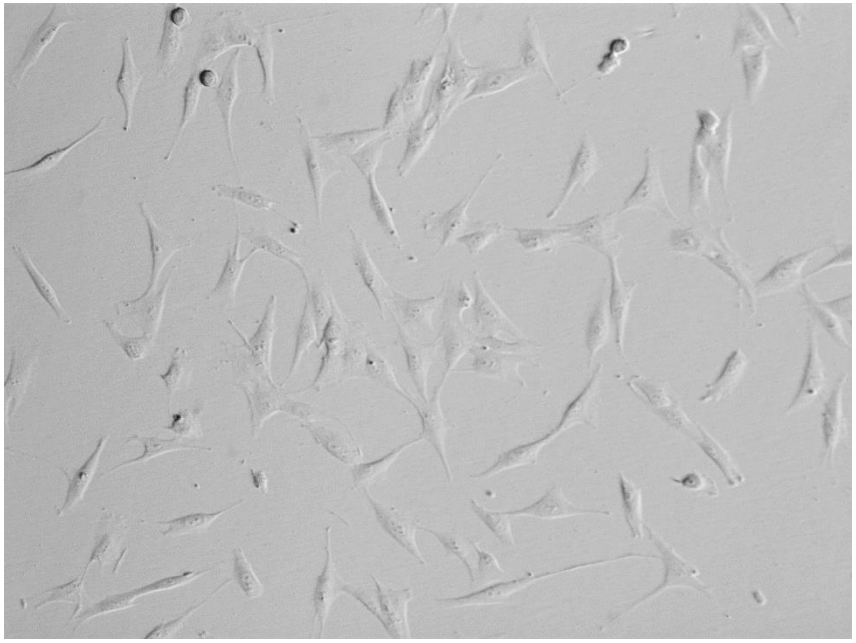


Exposed

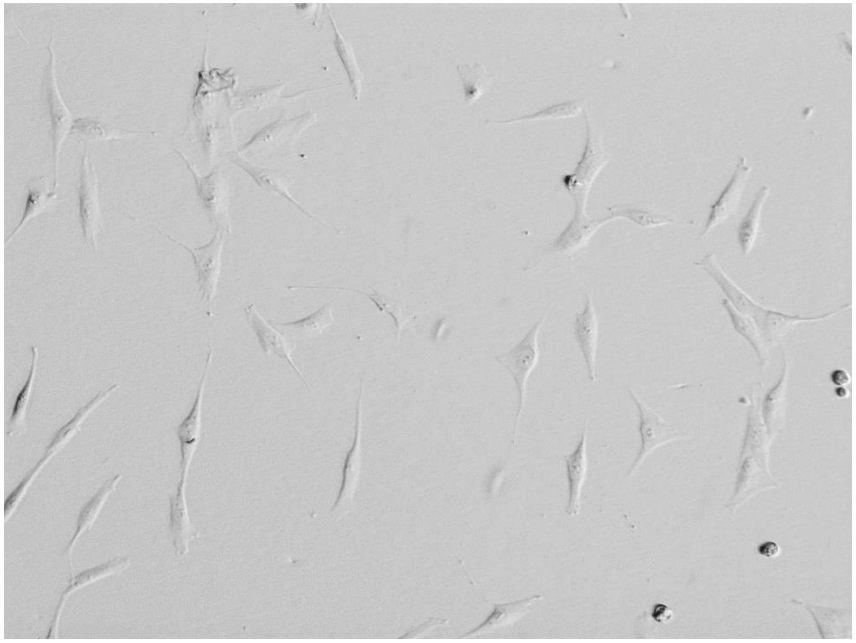


Control

Images: Day 3



Exposed



Control

Conclusions

- Based on results gathered from the ANOVA statistical analysis, it appears that exposure to cell phone radiation for **both** 1 day and 3 days **significantly affected** cancer cell proliferation.

- The null hypothesis is **rejected**.
- The alternative hypothesis is **accepted**.

- This suggests that cell phone radiation may cause existing cancer to grow at a faster rate, and does not suggest that cell phones **cause** cancer.

Future Changes

Limitations

- It is questionable that cell suspensions were perfectly homogenous.
- Pipetting was not perfectly synchronized.
- Cell phones were relatively close in proximity due to limited incubator space, possibly causing higher exposures than intended.

Extensions

- Different exposures of cell phones could be used (i.e. multiple cell phones, longer exposures).
- More replicates could be used.
- Cell phones with different SAR's could be compared.
- Test cell phone exposure on other cell lines (C2C12, 3T3)

References

- Mark Krotec, PTEI
- http://www.ncbi.nlm.nih.gov/pubmed/12160896
- http://cancerres.aacrjournals.org/content/40/3/734.full.pdf
- http://www.cancer.gov/cancertopics/factsheet/Risk/cellphones

Anova: Day 1						
SUMMARY						
Groups	Count	Sum	Average	Variance		
Exposed	6	311000	51833.33	14966667		
Control	6	173000	28833.33	8166667		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.59E+09	1	1.59E+09	137.2046	3.67E-07	4.964603
Within Groups	1.16E+08	10	11566667			
Total	1.7E+09	11				

Anova: Day 3						
SUMMARY						
Groups	Count	Sum	Average	Variance		
Exposed	6	1076000	179333.3	92666667		
Control	6	269000	44833.33	14566667		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	5.43E+10	1	5.43E+10	1012.199	2.21E-11	4.964603
Within Groups	5.36E+08	10	53616667			
Total	5.48E+10	11				