What is cancer?
Explaining Cancer to Children

- The body made of lots of cells
- Cells so small, you can only see under a microscope.
- Normal cells are the kind we need - they keep the body working well

Explaining Cancer to Children

- Cancer cells do not look like normal cells
- And they don't work like normal cells
- Cancer cells grow very fast
- They crowd out normal cells
How do we find cancer?
Explaining Cancer to Children

- When cancer cells grow, they get in the way of normal cells.
- A group of cells that keeps growing and crowding out normal cells is called a tumor.
How many of you know someone with cancer?

Explaining Cancer to Children

- Sometimes the part of the body where the cancer cells are growing does not work right, so the doctor may operate to remove as much of the cancer as possible.
Explaining Cancer to Children

- Sometimes people with cancer are given radiation therapy to help get rid of cancer cells.
- Radiation Therapy is treatment of cancer with radioactive rays.
- This is done with a very special machine that is made just for cancer.
- It is not the same as ordinary x-rays.
Explaining Cancer to Children

- The use of x-rays (or laser beam?) to destroy cancer
- Strong x-rays given to the part of body where cancer is to destroy cancer cells so they can't grow.

Cancer cannot be caught
The High School Presentation

- Career Day
- Math Day
- Anatomy
- Biology
- Science Day
- Physics class
- Outreach

Medical Physics as a Career

- American Association of Physicists in Medicine (AAPM)
- Presented for Math Day CDH
What is a Medical Physicist?

A medical physicist is a professional who specializes in the application of the concepts and methods of physics to the diagnosis and treatment of human disease.
What is the Medical Physicist’s Primary Discipline?

Source: 2002 AAPM Survey

UNSTABLE atoms emit energy

RF μwave infrared visible ulo x-ray γ-ray cosmic

low energy high energy
non-ionizing ionizing radiation

Tissue Bone

X-rays

I_1 I_2

Subject Contrast = I_1 - I_2
Cell Killing By Ionizing Radiation

Therapeutic Gain
A compromise between tumor control and normal tissue complications

Modern Radiation Therapy Using High Energy X-rays and Electrons
Therapy Responsibilities

- Equipment commissioning
Isocentric Patient Radiation Therapy
External Beam Radiation Therapy

3D Conformal Technique for Treating Prostate Cancer

The Math

\[ h(x) = f(x) \ast g(x) = \int_{-\infty}^{\infty} f(u)g(x-u)du \]
Therapy Responsibilities

• Management of special procedure: stereotactic radiosurgery
Frameless Radiosurgery

- Bite block with optically guided localization
- < 1 mm accuracy

Therapy Responsibilities

- Calibration and quality assurance

Monthly Linac Calibration: Varian 2100 C

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<th>18 MV</th>
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Therapy Responsibilities

- Calculation of patient dose

60Gy in 30 Fractions
\[ A = A_0 e^{-\lambda t} \]
\[ \int_0^\infty = 1.44 \]

Clinical Arenas
- Nuclear Medicine
- Radiation Safety
Emergency Management of Radiation Casualties

Homeland Security

Bone scan

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Types of Radiation

- Alpha: $^4\alpha^{++}$
- Beta: $^0\beta^-$
- Gamma and X-rays: $^0\gamma$
- Neutron: $^1\nu_n$

Distance from Source

Inverse Square Law: $\frac{1}{i} = \frac{d^2}{r^2}$
Therapy Responsibilities

- Equipment and facility specification and acquisition

\[ B_i = \frac{Pd^2}{WUT} \]

Shielding calculations

Magnetic Resonance Imaging (MRI)

Zero External Magnetic Field

Point in random directions
Magnetic Resonance Imaging (MRI)
In Strong External Magnetic Field

Some line up. Some line down. Just the majority line up.
Out of 1 million ~ 500,002 UP - 499,998 DOWN

Magnetic Resonance Imaging (MRI)
Flipping Spins

Computed Tomography Imaging
The Fourier transform of a musical chord is a mathematical representation of the amplitudes of the individual notes that make it up. The original signal depends on time, and therefore is called the time domain representation of the signal, whereas the Fourier transform depends on frequency and is called the frequency domain representation of the signal.
Outreach!!
Local community
Schools
Science Fair
Career Day
Science Camps
Acknowledgements

• “What is Cancer Anyway” by Karen L Carney, RN, LCSW
• Herb Mower
• Vertual Company
• Mahadevappa Mahesh

Star Wars accelerator!!