Cancer

- Cancer is one of the most common diseases in the developed world:
- 1 in 4 deaths are due to cancer
- 1 in 17 deaths are due to lung cancer
- Lung cancer is the most common cancer in men
- Breast cancer is the most common cancer in women
- There are over 100 different forms of cancer
Cancer

- The division of normal cells is precisely controlled. New cells are only formed for growth or to replace dead ones.
- Cancerous cells divide repeatedly out of control even though they are not needed, they crowd out other normal cells and function abnormally. They can also destroy the correct functioning of major organs.
What causes cancer?

- Cancer arises from the **mutation** of a normal gene.
- Mutated genes that cause cancer are called **oncogenes**.
- It is thought that several mutations need to occur to give rise to cancer.
- Cells that are old or not functioning properly normally self destruct and are replaced by new cells.
- However, cancerous cells do not self destruct and continue to divide rapidly producing millions of new cancerous cells.
- A factor which brings about a mutation is called a **mutagen**.

- A mutagen is **mutagenic**.

- Any agent that causes cancer is called a **carcinogen** and is described as **carcinogenic**.

- So some mutagens are carcinogenic.
Carcinogens

- **Ionising radiation** – X Rays, UV light (sun and....tanning beds!)

- **Chemicals** – tar from cigarettes

- **Virus infection** – papilloma virus can be responsible for cervical cancer.

- **Hereditary predisposition** – Some families are more susceptible to getting certain cancers. Remember *you can’t inherit cancer* its just that you maybe more susceptible to getting it.
Benign or malignant?

- **Benign tumours** do not spread from their site of origin, but can crowd out (squash) surrounding cells eg brain tumour, warts.

- **Malignant tumours** can spread from the original site and cause **secondary tumours**. This is called **metastasis**. They interfere with neighbouring cells and can block blood vessels, the gut, glands, lungs etc.

- Both types of tumour can tire the body out as they both need a huge amount of nutrients to sustain the rapid growth and division of the cells.
Tanning

- Tans are caused by harmful ultraviolet (UV) radiation
- Indoor ultraviolet (UV) tanners are 74 percent more likely to develop melanoma than those who have never tanned indoors.
Tanning

SunMaster
ClearTech Technology

We combine Sol Glass plus our proprietary phosphors to create the most powerful 100 watt lamps in America.

FIGURE A
UVB NARROWBAND (311 nanometers)

NATURAL SOLAR RADIATION AT THE EARTH’S SURFACE

UV Spectra of Solar and Tanning Bed UV Sources

UVB
UVA
VIOLET
VISIBLE LIGHT
IR

W/m²

Wavelength (nm)
a Benign mole  
b Melanoma
The Development of Cancer

- Within every nucleus of every one of the human body's 30 trillion cells exists DNA, the substance that contains the information needed to make and control every cell within the body. Here is a close-up view of a tiny fragment of DNA.
1. DNA of a normal cell

- This piece of DNA is an exact copy of the DNA from which it came. When the parent cell divided to create two cells, the cell's DNA also divided, creating two identical copies of the original DNA.
2. Mutation of DNA

Here is the same section of DNA but from another cell. If you can imagine that DNA is a twisted ladder, then each rung of the ladder is a pair of joined molecules, or a base pair. With this section of DNA, one of the base pairs is different from the original.

This DNA has suffered a **mutation**, either through mis-copying (when its parent cell divided), or through the damaging effects of exposure to **radiation** or a **chemical carcinogen**.
3. Genetically altered cell

- Body cells replicate through mitosis, they respond to their surrounding cells and replicate only to replace other cells. Sometimes a **genetic mutation** will cause a cell and its descendants to reproduce even though replacement cells are not needed.

The DNA of the cell highlighted above has a **mutation** that causes the cell to replicate even though this tissue doesn't need replacement cells at this time or at this place.
The genetically altered cells have, over time, reproduced unchecked, crowding out the surrounding normal cells. The growth may contain one million cells and be the size of a pinhead. At this point the cells continue to look the same as the surrounding healthy cells.

After about a million divisions, there's a good chance that one of the new cells will have mutated further. This cell, now carrying two mutant genes, could have an altered appearance and be even more prone to reproduce unchecked.
5. Third mutation

Not all mutations that lead to cancerous cells result in the cells reproducing at a faster, more uncontrolled rate. For example, a mutation may simply cause a cell to keep from self-destructing. All normal cells have surveillance mechanisms that look for damage or for problems with their own control systems. If such problems are found, the cell destroys itself.

Over time and after many cell divisions, a third mutation may arise. If the mutation gives the cell some further advantage, that cell will grow more vigorously than its predecessors and thus speed up the growth of the tumour.
“Science has presented us with a hope called stem-cell research, which may provide our scientists with answers that have so long been beyond our grasp.”

Nancy Reagan

"If the potential of stem cell research is realized, it would mean an end to the suffering of millions of people. If stem cell research succeeds, there isn’t a person in the country who won’t benefit, or know somebody who will."

Michael J. Fox
Stem Cell Characteristics

- ‘Blank cells’ (unspecialized)
- Capable of dividing and renewing themselves for long periods of time (proliferation and renewal)
- Have the potential to give rise to specialized cell types (differentiation)
Kinds of Stem Cells

Embryonic stem cells
- five to six-day-old embryo
- Tabula rasa

Embryonic germ cells
- derived from the part of a human embryo or fetus that will ultimately produce eggs or sperm (gametes).

Adult stem cells
- undifferentiated cells found among specialized or differentiated cells in a tissue or organ after birth
- appear to have a more restricted ability to produce different cell types and to self-renew.
Embryonic Stem Cells—more potential to become any type of cell
Adult stem cells

- limited in what the cells can become
Stem Cell Applications

• Tissue repair - nerve, heart, muscle, organ, skin, regenerate spinal cord, heart tissue or any other major tissue in the body.
• Cancers
• Autoimmune diseases - diabetes, rheumatoid arthritis, MS
How to use stem cells

1. Isolate cells from patient (skin or fibroblasts); grow in a dish
2. Treat cells with “reprogramming” factors
3. Wait a few weeks
4. Pluripotent stem cells
5. Change culture conditions to stimulate cells to differentiate into a variety of cell types
   - Blood cells
   - Gut cells
   - Cardiac muscle cells