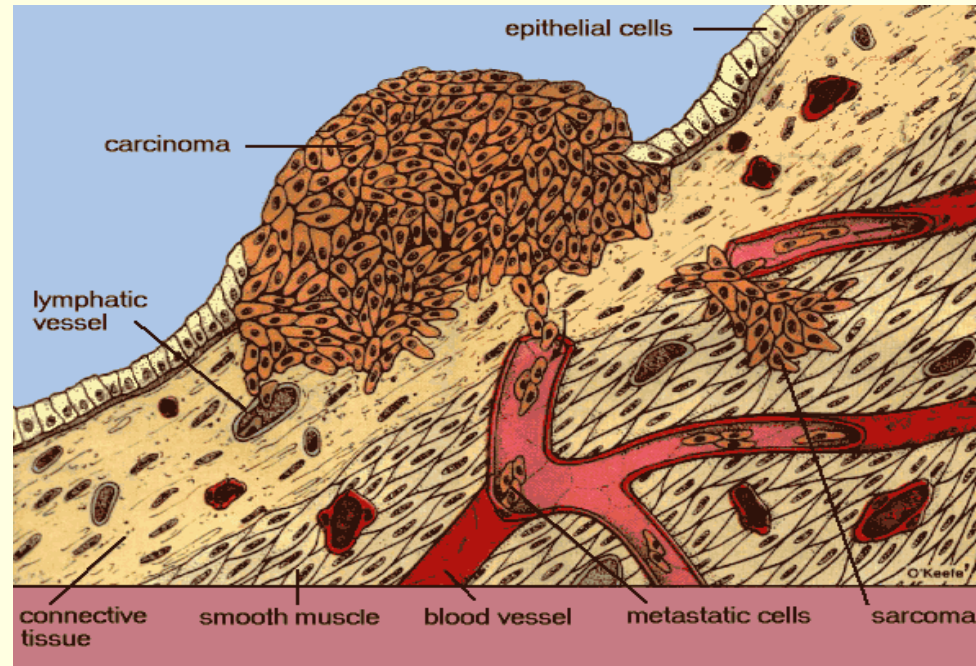


How Cancer Develops, Grows & Spreads



Maria Vincent
Director of Nursing & Patient Services



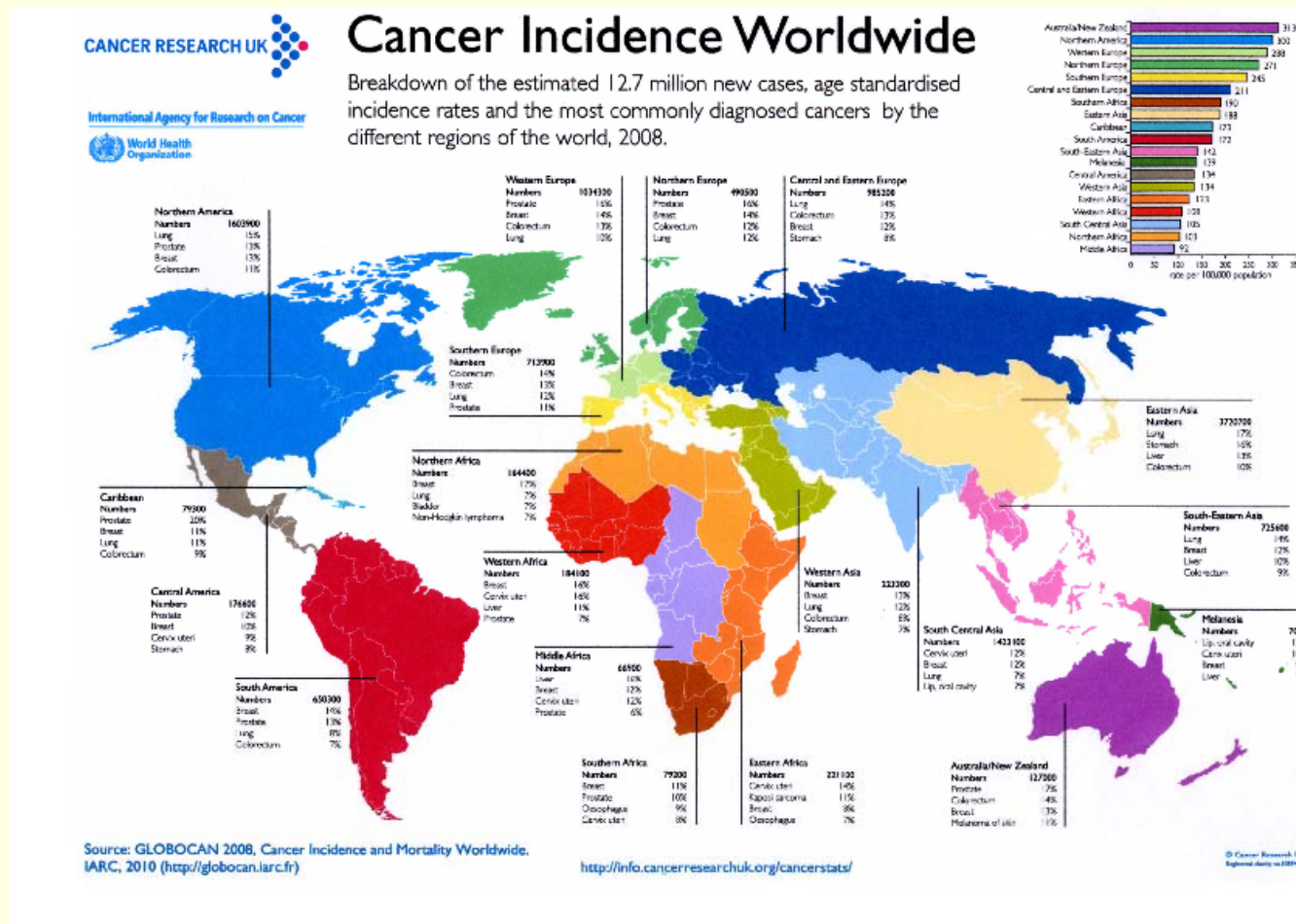
Rayson Homes Ltd

Everybody Deserves High Quality Care

Each year more than a quarter of a million people are newly diagnosed with cancer !

More than 1 in 3 people will develop some form of cancer during their lifetime

The incidence (diagnosis) and the mortality (death) varies across the world.



Mortality

Why I mortality is improving?

Health promotion

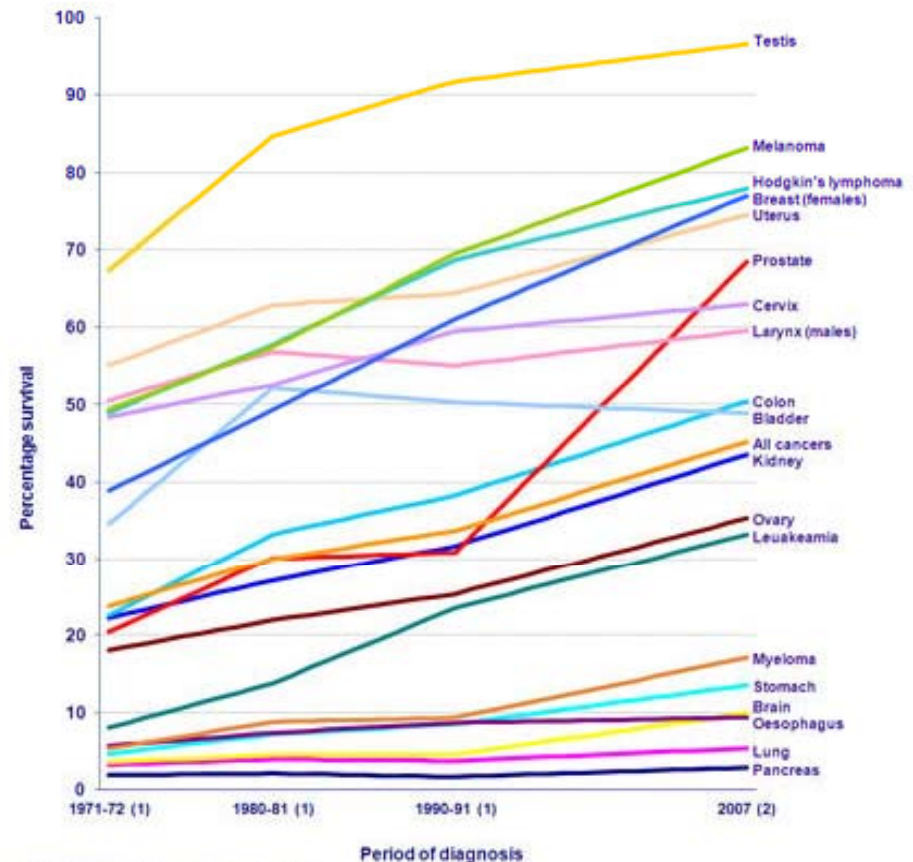
Early detection

Symptoms

Screening programmes

Better treatment

Figure 1.2: Relative survival (%), adults (15-99 years), selected cancers, England and Wales: survival trends for selected cancers 1971-2007



(1) 1971-1991 Cohort analysis - actual survival
(2) 2007 Hybrid analysis - predicted survival

So what causes cancer ?





Cell Growth & Differentiation



Normal cells

Stem cell theory

Human life begins with a single cell

Cell division (2,4,8)

Trigger mechanisms cause cells to specialise

Process whereby cells develop specific structures & functions is called 'differentiation'

- Cells make Tissue
- Tissues combine to form Organs

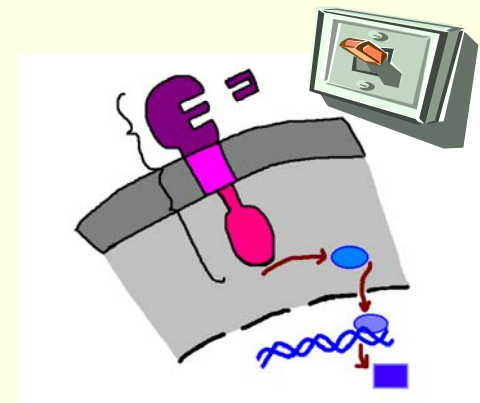
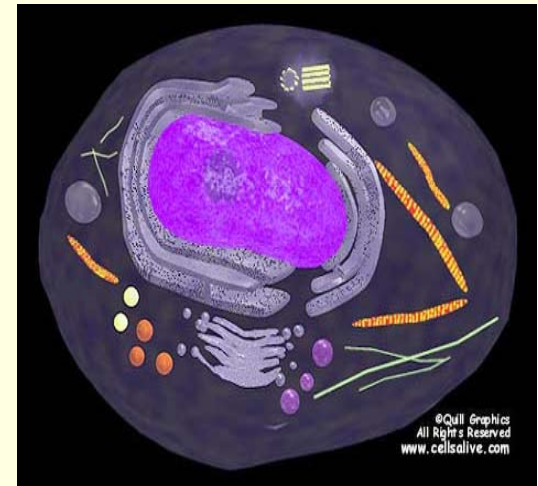
Each Tissue or Organ is developed from its own population of 'Parent' or Stem cells

Cells

The human body is made up of trillions of cells

- Each cell has a fat bilayer membrane which separating the cytoplasm from the surrounding liquid environment
- Channels within this membrane allow the controlled passage of chemicals into & out of the cell
- There are protein molecules embedded within the membrane and this is part of the Cell Signalling Pathway through which a cell receives signals to undergo cell division (mitosis) or death (apoptosis).

Mitosis & apoptosis are used to maintain body's stasis



Cells

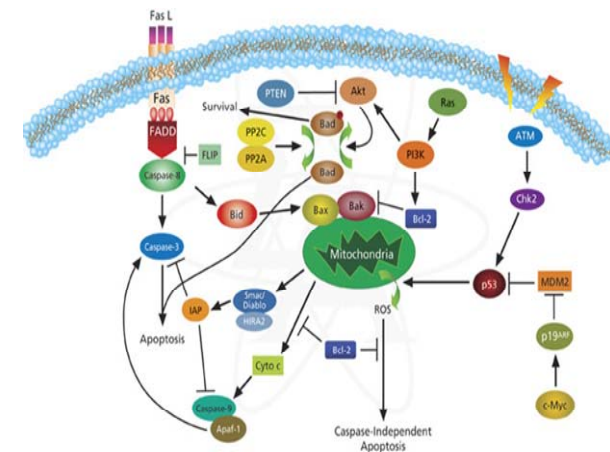
The Nucleus contains DNA and has a porous membrane

The Cytoplasm is a clear thick liquid (cytosol) which surrounds the nucleus

This liquid contains thousands of enzymes that induce or speed up chemical reactions within the cell

Activation and Inhibition of Apoptosis

SIGMA-ALDRICH



http://www.sigmaaldrich.com/Area_of_Interest/Europe_Home/UK.html

DNA



2 long chains of DNA are twisted into a double helix to form a chromosome (There are 23 pairs of chromosomes within the nucleus of a cell).

They are formed from nucleotides which are joined by hydrogen bonds.

The most common nucleotides are divided into 2 groups

- Purines
(where the base pairs are Adenine and Guanine)
- Pyrimidines
(where the base pairs are Thymine and Cytosine)

N.B. Guanine can only ever pair Cytosine and Adenine can only ever pair with Thymine (or Uracil instead of Thymine in the case of RNA)

DNA controls the form and function of every living plant and animal on earth and is the way hereditary information is transferred to new daughter cells

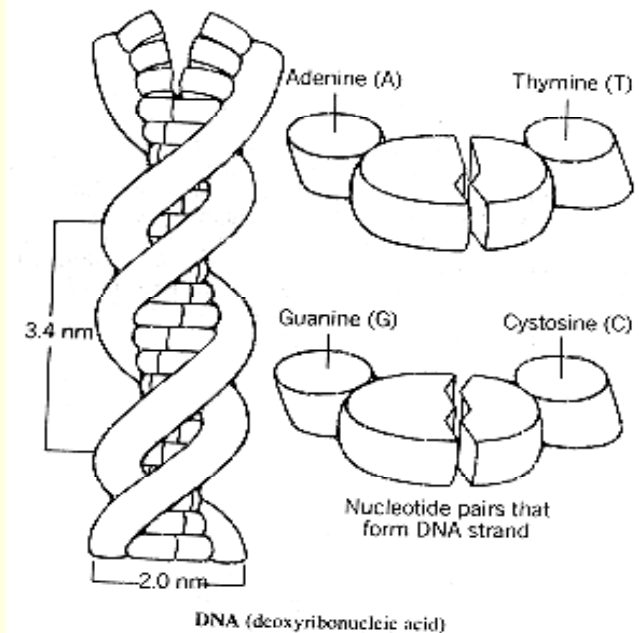
Chromosome



DNA



ADAM.



DNA

A sequence of base pairs along a strand of DNA spells out a chemical message to a cell (words are always 3 letters in length and these are called a 'codon')

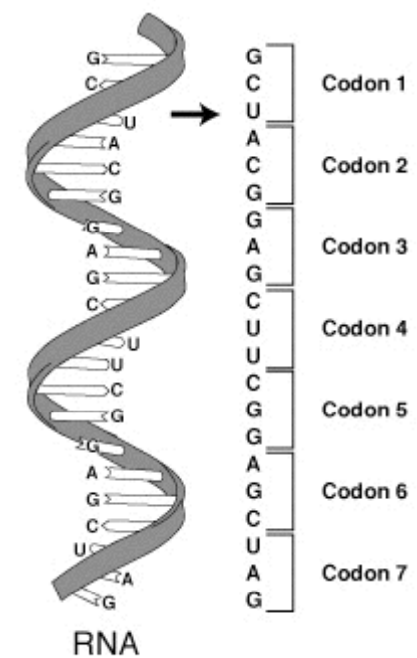
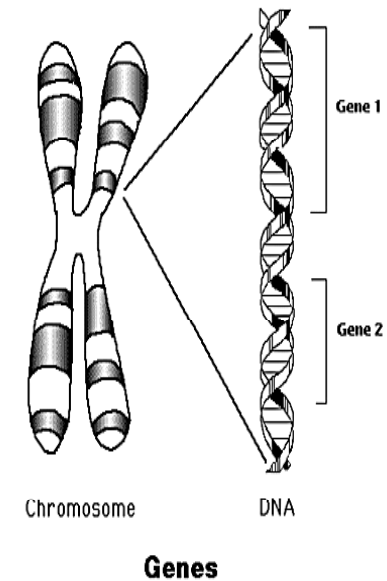
Each sequence of codons is a recipe to make a protein.

Proteins control everything that happens inside our cells.

- A complete message is called a 'gene' and there are approximately 24,000 genes in every cell.
- Although each pair of chromosome has genes in the same order, their form may be different e.g. instructions for eye colour.

[Video clip](#) (3 minutes)

<http://www.youtube.com/watch?v=eOvMNOMRRm8&feature=related>



Ribonucleic acid

<http://commons.wikimedia.org/wiki/File:RNA-codon.png>

Maintaining Control

Cell division (mitosis) & death (apoptosis) are used to maintain the body's stasis

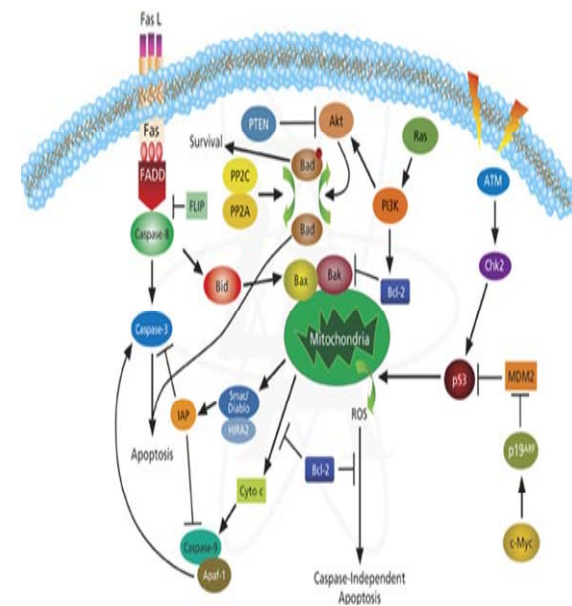
There are many pathways in which mitosis and apoptosis can be triggered - via a variety of stimuli, including those from cell surface receptors ... it's like the London underground)

Processes are multi-faceted, complex and involve many proteins.

Mutation laden cells are generally prevented from dividing and undergo apoptosis N.B. Normal cells have a finite number of population doublings (aging)

Activation and Inhibition of Apoptosis

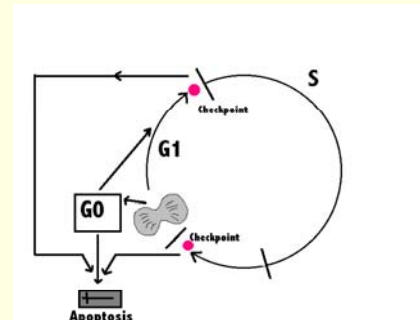
SIGMA-ALDRICH



http://www.sigmaaldrich.com/Area_of_Interest/Europe_Home/UK.html

Cell Cycle

Cells in the body are continuously wearing out and need to be replaced. The cell cycle is the process by which this is achieved.

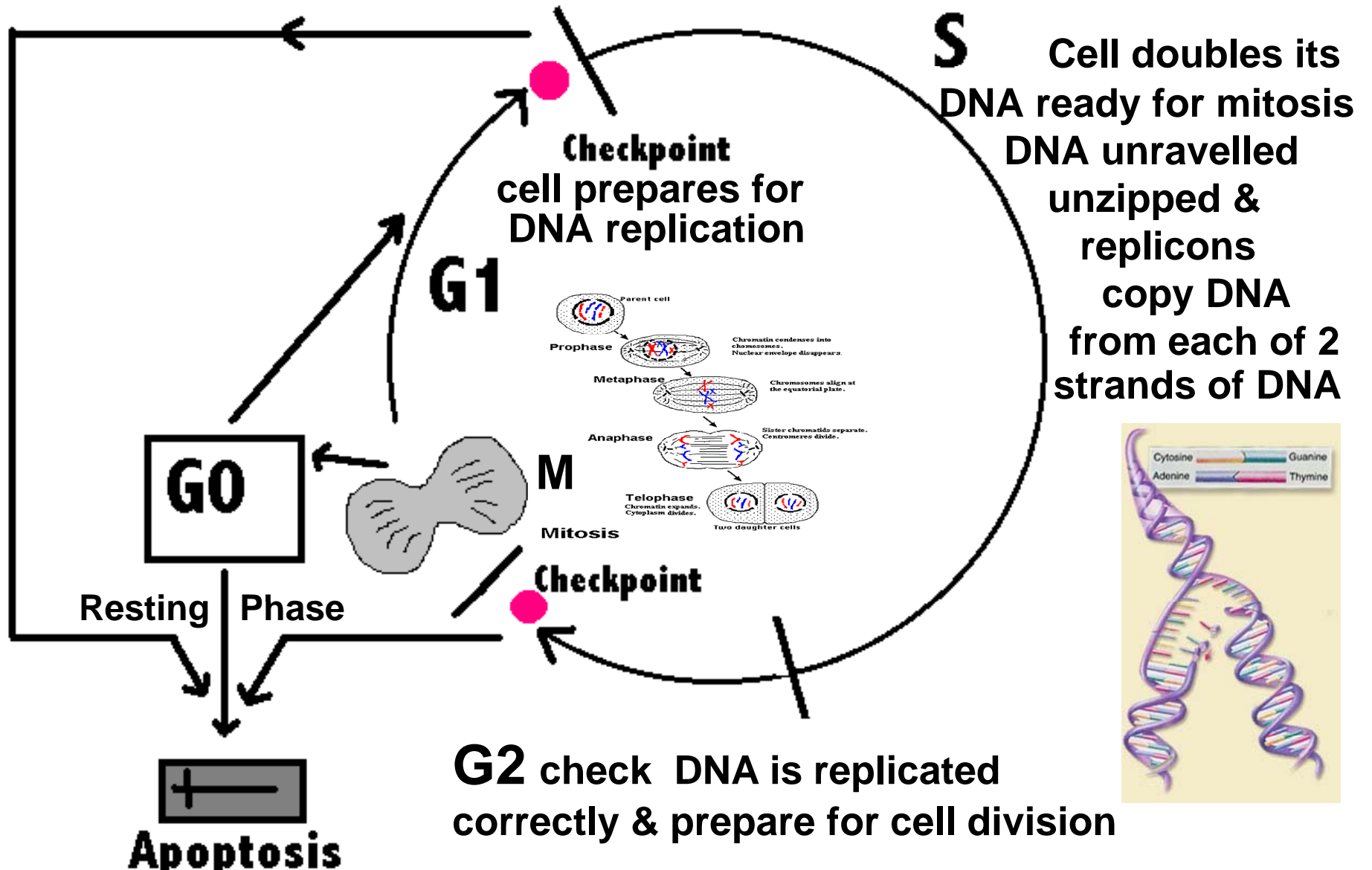


Some cells are replaced rapid e.g. white blood cells, skin, mucosa, while others rarely under go this process e.g. neurons or heart cells

[Video clip explaining the cell cycle \(3 minutes\)](#)

<http://www.youtube.com/watch?v=lf9rcqjfx34>

Cell Cycle



What is cancer

[A general video overview of cancer \(2 minutes\)](http://www.youtube.com/watch?v=A1Fkdt-2veM&feature=related)
<http://www.youtube.com/watch?v=A1Fkdt-2veM&feature=related>

[Additional video](http://www.youtube.com/watch?v=j_wRpa2b5XI&feature=related)
http://www.youtube.com/watch?v=j_wRpa2b5XI&feature=related

Carcinogenesis

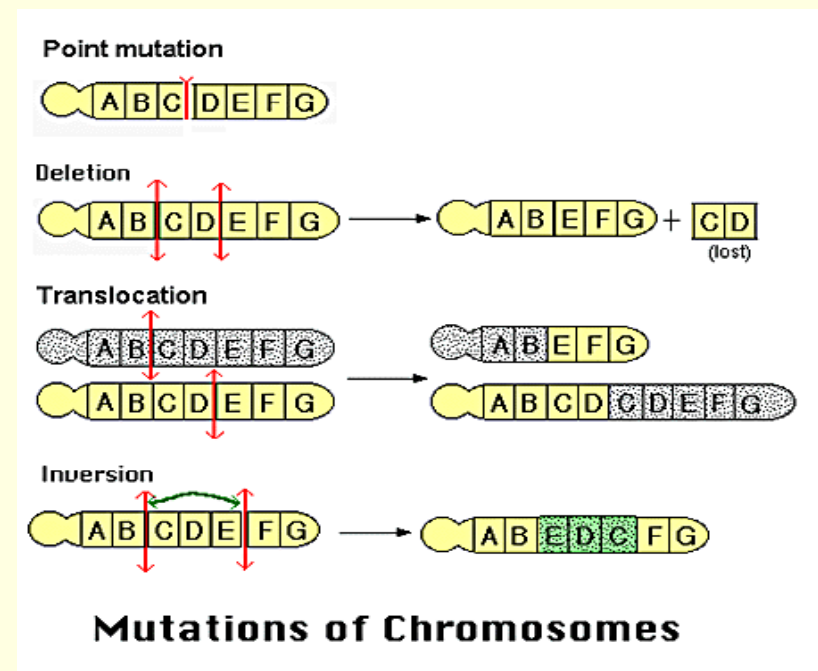
This is the process by which exposure to 'agents' results in an alteration (mutation) in the DNA of a cell which leads to the development of cancer

A mutation causes an inaccuracy in the initial recipe which may result in the production of a different protein

[A video showing the effect of a mutation](#)

(1 minute)

<http://www.youtube.com/watch?v=I96PKVfGh-0&NR=1>



Carcinogenesis

Carcinogenesis is more specifically an alteration (mutation) affecting Proto-Oncogenes and / or Tumour Suppressor Genes

These genes play a significant role in regulating cell division

[Basic video explaining Proto-oncogenes & Tumour suppressor genes
http://www.youtube.com/watch?v=eoWRZbtqB_s&feature=related](http://www.youtube.com/watch?v=eoWRZbtqB_s&feature=related)

Proto- Oncogenes (PO)

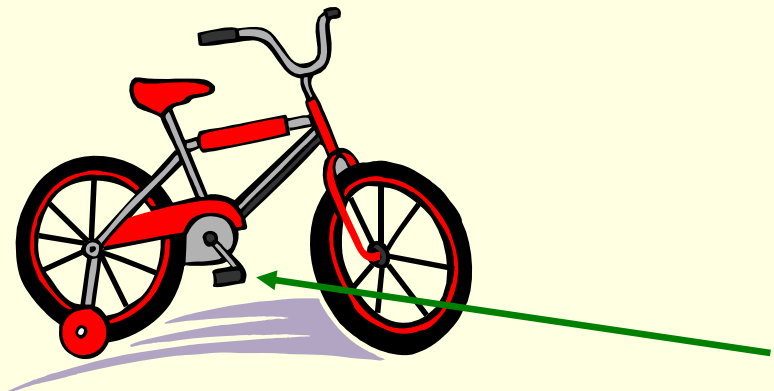
These are genes that are essential for maintaining / controlling normal tissue growth & repair

Mutations in these genes are called 'oncogenes'

Mutations are acquired

Lead to abnormally excessive division (proliferation) of cells

Their effect is always seen (dominantly expressed)



Oncogenes (PO)

Excessive division can result in tumours which are

- **Benign** (maintain sensitivity to external stimuli)
- **Malignant** (independent of external factors)

Advanced video describing how a proto-oncogene becomes an oncogene

<http://www.youtube.com/watch?v=2wIVwZkslt4>

Tumour Suppressor Genes (TSG)

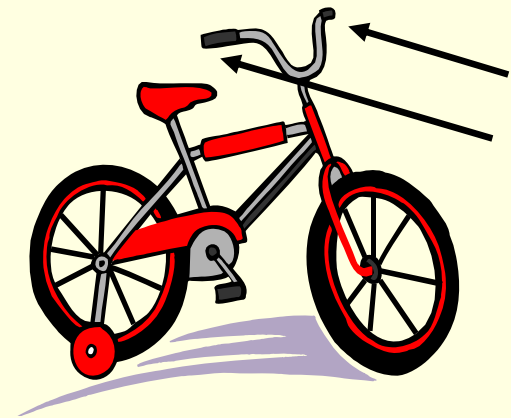
These genes work with the DNA repair system to maintain the stability of the body's genetic information (slow down cell division)

Their effect is only seen when both copies of the gene are mutated (recessive)

1st mutation is inherited or acquired

2nd mutation is acquired

Lead to abnormal proliferation of cells



Video discussing tumour suppressor genes

<http://www.youtube.com/watch?v=iLK3jy-kGvs&feature=related>

Cancer development

The development of Cancer is a Multi Step Process involving:

Creation

Mutations in Proto- Oncogenes and Tumour Suppressor Genes

Survival

Overcome the immune system

Development of a blood supply (angiogenesis)

Spread



Survival - Immunology & Angiogenesis



The body has natural 'killer cells' that protect the body
As cancer cells are derived from normal cells they are often recognised as 'self'

(unless they express an inappropriate antigen as part of its abnormal function)

The immune system's reaction to a tumour cell may therefore be inhibited, inconsistent or ineffective



Cancer cells initially acquire their nutrients via diffusion

As their numbers grow and they increase in size they need to recruit their own blood supply.

The tumour therefore begins to secrete growth factors which enable budding capillaries to be recruited

Spread

Normal cells need a basement membrane for anchorage but cancer cells lose this dependency on the basement membrane

Cancer

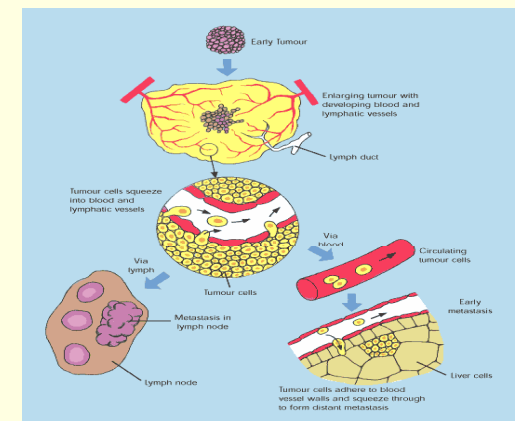
In situ - Confined to basement epithelial layer

Local spread – The tumour breaks through the basement membrane, secretes collagenases and other enzymes that destroy the connective tissue enabling it to invade into the connective tissue

Metastatic spread – 3 routes

- Lymphatic channels
- Venous channels
- Seedlings across body cavities

[Video showing cancer development \(1 minute\)](http://www.youtube.com/watch?v=5pP4bMm9yNQ)
<http://www.youtube.com/watch?v=5pP4bMm9yNQ>



What can you do to help yourself ?

Reducing exposure to 'agents' that can cause the DNA in our cells to become damaged can reduce the chances of an individual developing cancer.

There are 5 key agents linked to cancer:-

- **SMOKING**
- DIET & OBESITY
- DIET
- RADIATION
- VIRUSES

The biggest risk factor is Smoking



29% of all cancer deaths are linked to cigarette smoking
(pipe and tobacco)

Of most significance is the number of years an individual has smoked followed by the number they smoke a day

Passive (& 3rd hand) smoking can also increase your risk by about 25% - the level of risk is dependant on the amount of cigarette smoke an individual is exposed to

Smoking increases the risk of an individual developing a number of cancers.

The most common being Lung Cancer where 9/10 cases are due to smoking !



George Harrison (The Beatles)
Died aged 58yrs – Lung cancer

Roy Castle (Record Breakers)
Non smoker (Worked in pubs & clubs)
Died age 62yrs – Lung Cancer



Smoking increases the risk of an individual developing a number of other cancers including ...

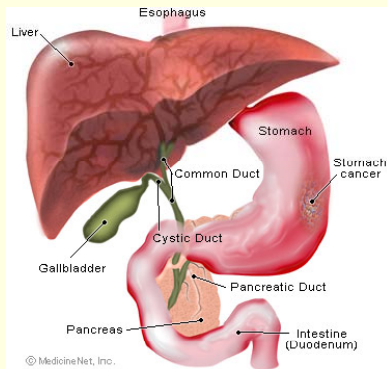
Head and neck cancers (mouth, nose, voice box)

Oesophagus (up to 100 times the risk if you drink and smoke heavily)

Stomach

Liver (10 times the risk if you smoke and drink)

Pancreas (Smoking is one of the biggest risk factors for this type of cancer)



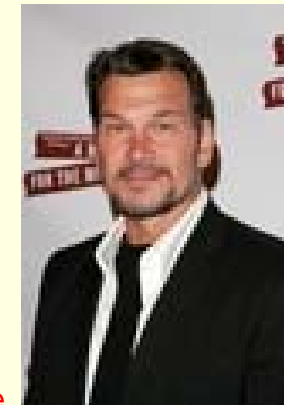
Bladder and Kidney

Cervical

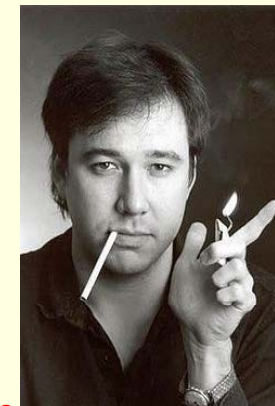
Myeloid Leukaemia



John Wayne
Died aged 72yrs – Stomach cancer



Patrick Swayze
Died aged 57yrs – Pancreatic cancer
Video of Patrick's story
<http://www.youtube.com/watch?v=YX9TZWclmHE&feature=related>



Bill Hicks
Died aged 32yrs – Pancreatic cancer

Approximately 25% of cancer deaths are thought to be related to obesity or diet



Ronald Reagan & Sharon Osborne
Bowel cancer



Obesity

Being overweight can increase the risk of developing many cancer



Apple-shaped people who put on *weight around their stomach* may be at higher risk than pear-shaped people who put on weight around their hips.

Diet

Its difficult to identify a single food as an individuals diet is varied however it has been suggested that:

- Eating large amounts of **red or processed meats** can increase the risk of developing pancreatic cancer by up to 50%.

(These contain chemical 'agents' or stimulate bacteria in the gut to produce chemical 'agents')



- Eating **saturated fats** can increase the risk of breast cancer

(Thought to increase the amount of oestrogen in the body)

Diet

- Cooking at **high temperatures** (frying / barbecuing)

(This can produce chemical agents that can damage DNA)



- **Salty or foods preserved with salt** could increase the risk of stomach cancer

(Thought to damage the lining of the stomach and cause inflammation)



Alcohol increases the risk of an individual developing a number of cancers including ...

■ Mouth

6 units a day triples the risk of developing mouth cancer ...

There is a 20 to 50 fold increase risk of an individual developing a head neck cancer if they are also a smoker

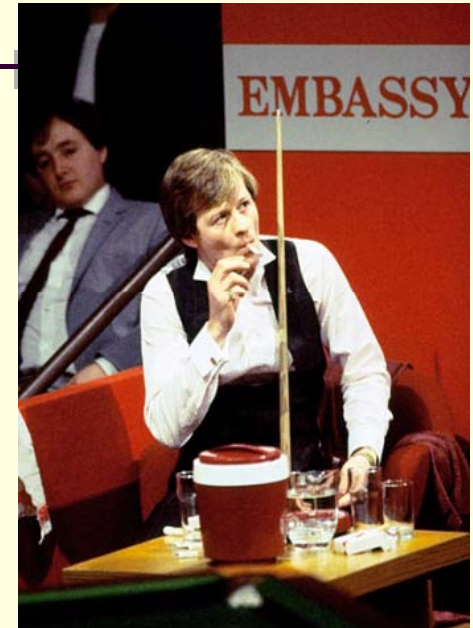
■ Oesophagus

■ Liver

■ **Breast** - Every unit increases the risk

■ **Bowel** - 2 units a day increases your risk by 8%

N.B. It has also been suggested that drinking during pregnancy can increase the risk of a child developing leukaemia



Alex 'Hurricane' Higgins
Diagnosed aged 49 yrs
Died aged 61 years
Throat Cancer (lost all his teeth)



Daily Mail

Radiation

Radiation increases the risk of an individual developing a number of cancers

Ionising radiation is the type of radiation that is of greatest risk, e.g. x-rays / radioactive materials



Sun light (which is a form of non-ionising radiation), can also increase the risk.



Leukemia is the most common radiation-induced cancer which may occur as early as a few years after radiation exposure.

Inherited

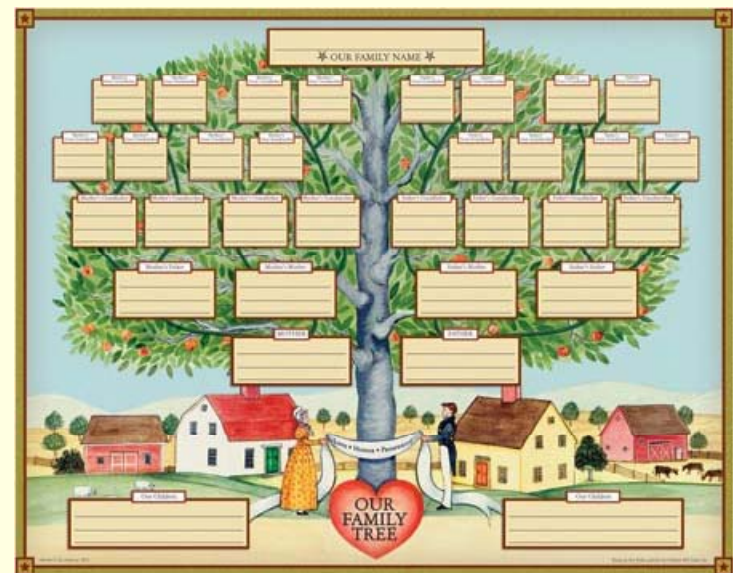
Less than 10% of cancers are thought to be due to an inherited disposition

Cancer is more likely to be due to an inherited disposition if:

- A number of relatives are effected at a young age and across a number of generations
- Certain types of cancers can suggested an inherited disposition e.g. breast, ovarian, prostate, bowel, skin, endometrial

Not everyone who has an inherited disposition develops cancer in their lifetime and this may perhaps be due to:

- Health promotion behaviours
- Gene modifiers



Some health problems can increase an individuals risk of developing cancer

- **Having had an organ transplant** (Primarily due to the drugs that are subsequently used to suppress their immunity and reduce the risk of organ rejection)

- **Cirrhosis of the liver**

- **Some virus's** (HPV, Hepatitis B or C, HIV / Aids)

The HPV virus increases the risk of developing cervical, vulval, vaginal, anal and some types of head and neck cancer too



- **Some bacteria** (Helicobacter)

- **Some inflammatory diseases**

(Primarily due to the drugs that are used to suppress their immunity)

- Rheumatoid arthritis
- Bowel (crones, colitis)
- Barretts oesophagus



People who have certain jobs can be at increased risk of developing cancer

This may be due to the 'agents' they are exposed to:

Chemicals

Inhalation – Asbestos, Dust, Fumes (e.g. Coal, Steel, Exhaust fumes etc)
Contact with skin (e.g. printing dye)

Radiation

Other occupations at increased risk

Miners (coal dust)
Building trade (asbestos)
Those working outdoors (sun)
Car / Garage industry (diesel)



Where you live can also increase your risk and this is related to exposure to Radon Gas (e.g. West Country / Peak District)

...how do 'agents' increase the
risk of cancer?

Chemicals

Alcohol is converted into a chemical that can damage DNA

Chemical carcinogen - converted and binds with the DNA
and its either

Detoxified & eliminated

DNA damage

DNA single or double strand breaks
/ chemical changes in a nucleotide
which is either

Repaired

Not repairable - Apoptosis

Repair system fails - Mutation

Effective chemical carcinogens have an initiator that mutates the DNA and
a promoter that stimulates cell division

Radiation

Ionizing radiation damages cells by disrupting their molecular structures, including the DNA

This acts in the same way as a chemical carcinogen - the most important damage is DNA double strand breaks

The interaction of ionizing radiation with DNA depends upon the

- Energy of radiation
- Dose
- Type of particles

Virus

Virus carry oncogenes into the cell

These oncogenes can be incorporated into the cell's DNA but are very rare e.g. HPV, Epstein barr, Hepatitis, AIDS

Conclusion

Remember that the development of Cancer is a Multi Step Process and that **YOU CAN** reduce **YOUR RISKS** of developing cancer.

....SO DO IT NOW



If you have any symptoms get them checked out as early detection saves lives



<http://www.google.co.uk/imgres?imgurl=http://www.shareworld.co.uk/uploads/images/question-graphic.jpg&imgrefurl=http://www.shareworld.co.uk/index.php/resources/questions/&h=346&w=347&sz=23&tbid=Ro7UEEvhpOR8mM:&tbnh=91&tbnw=91&prev=/search%3Fq%3Dpicture%2Bany%2Bquestions%26tm%3Dsch%26bo%3Du&zoom=1&q=picture+any+questions&docid=Jl2pMmlvW063DM&sa=X&ei=82zNTsXIMYPB8QO42Gw&ved=0CCgQ9QEwAg&dur=1825>

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