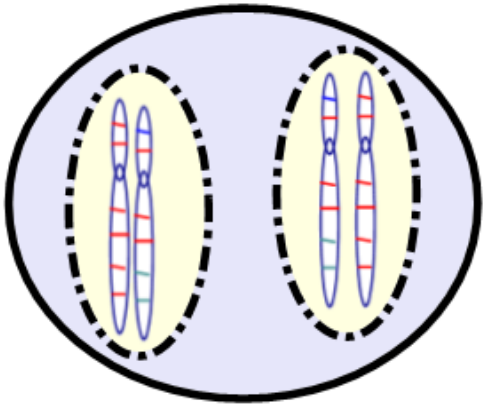


Cell Division

and Cancer

Stephen Taylor

Bandung International School

Produce an A3 Poster of the eukaryote cell cycle

Generate a pie chart using data from this online mitosis lab activity:
http://www.biology.arizona.edu/cell_bio/activities/cell_cycle/01.html

- State four processes that require cell division using mitosis
- Stages must be in sequence, starting with interphase
- Explanations of G1, S and G2 phases of interphase are essential
- Size of each 'slice' is relative to the time a cell spends in that stage
- Stages must have labelled diagrams and explanations of what is happening
- Clear distinction between mitosis and cell division
- Explain how cytokinesis occurs

Key vocab:

chromosomes

centromeres

centrioles

spindle microtubule

supercoiling

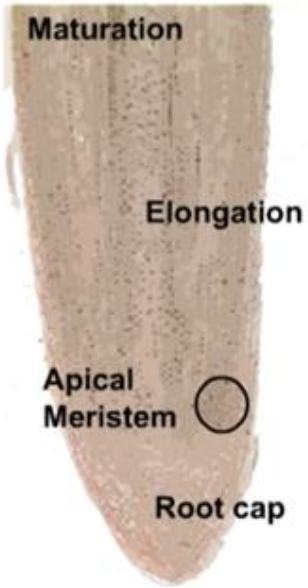
sister chromosomes

sister chromatids

poles

cytokinesis

This is what the stages look like:



Onion root tip Mitosis

next

Roots consist of different regions. The root cap functions in protection. The apical meristem is the region that contains the highest percentage of cells undergoing mitosis. The region of elongation is the area in which growth occurs. The region of maturation is where root hairs develop and where cells differentiate to become xylem, phloem, and other tissues.

http://bioweb.wku.edu/courses/biol121/Genetics/genetics.asp

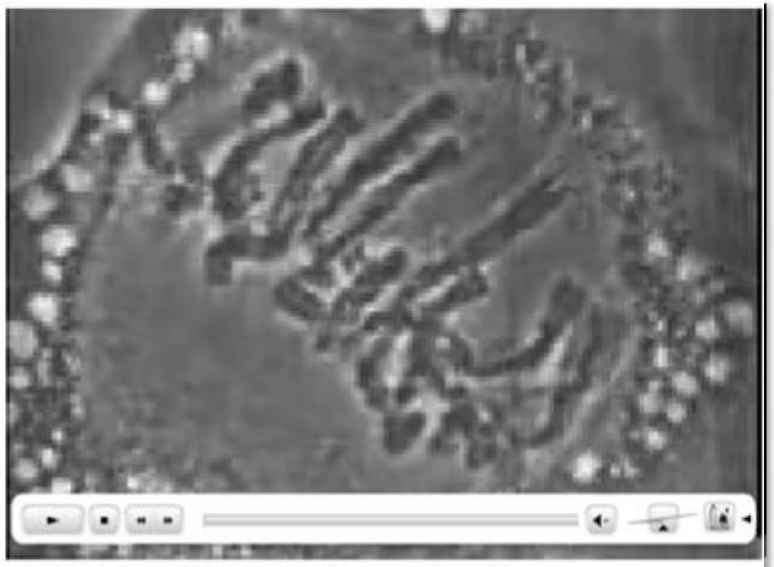
Why do cells divide?

Remember that large cells have a reduced SA:VOL ratio and are therefore much less efficient than smaller cells.

If an organism is to grow larger, it needs to produce more cells - and each of those cells needs a copy of the organism's DNA.

Cell division allows for growth of the organism by producing more copies of cells - and also allows for more cell differentiation to occur.

Cell division footage:



http://www.youtube.com/watch?v=s1ylUTbXyWU

Mitosis is happening most frequently in developing embryos.

New cells are also needed on a regularbasis toreplace dead, damaged or infected cells.

sea anemones reproduce asexually

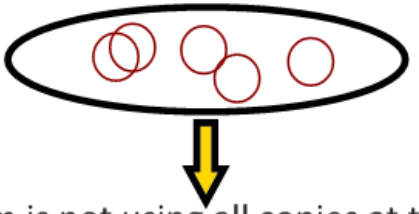
http://www.valdosta.edu/~jlgoble/Sea%20Anemone%20Diadumene%20Dia%2030cm%201.JPG

Cell division (specifically through mitosis) is also used in asexual reproduction (essentially self-replication).

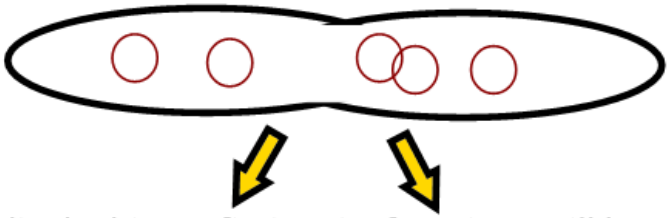
embryonic cells image from: http://www.rso.cornell.edu/progressive/articles.php?id=80

Prokaryotes divide by binary fission - why can't eukaryotes?

Bacteria have many copies of looped DNA.



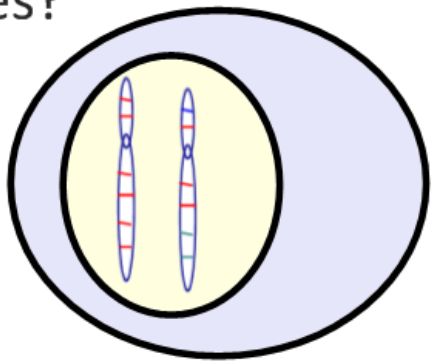
The bacterium is not using all copies at the same time.



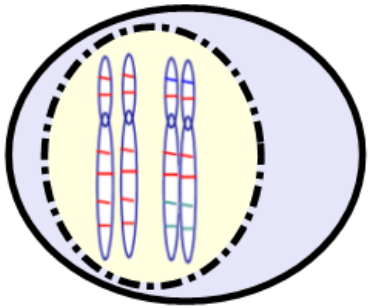
If it splits by binary fission, its functions will be unaffected.

Each new daughter cell has a copy of DNA.

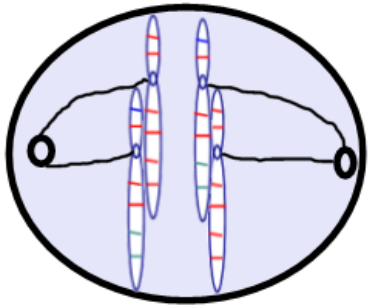
Eukaryotes have chromosomes, carrying genes, in their nucleus. Proper function of the cell depends on their having the complete set.



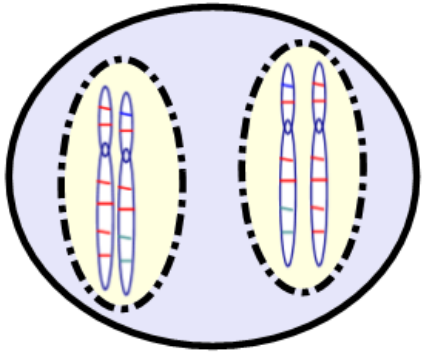
This means that the cell must make a copy of every chromosome before dividing...



... and then it must make sure that each new daughter cell gets the right number of each chromosome...



Mitosis is division of the eukaryote nucleus, making sure that each new daughter cell gets a full set of chromosomes and is therefore genetically identical to the parent cell.



... which is why they go through the process of MITOSIS.

A Chromosome Story

Every eukaryote has genes on chromosomes - storage units in the nucleus.

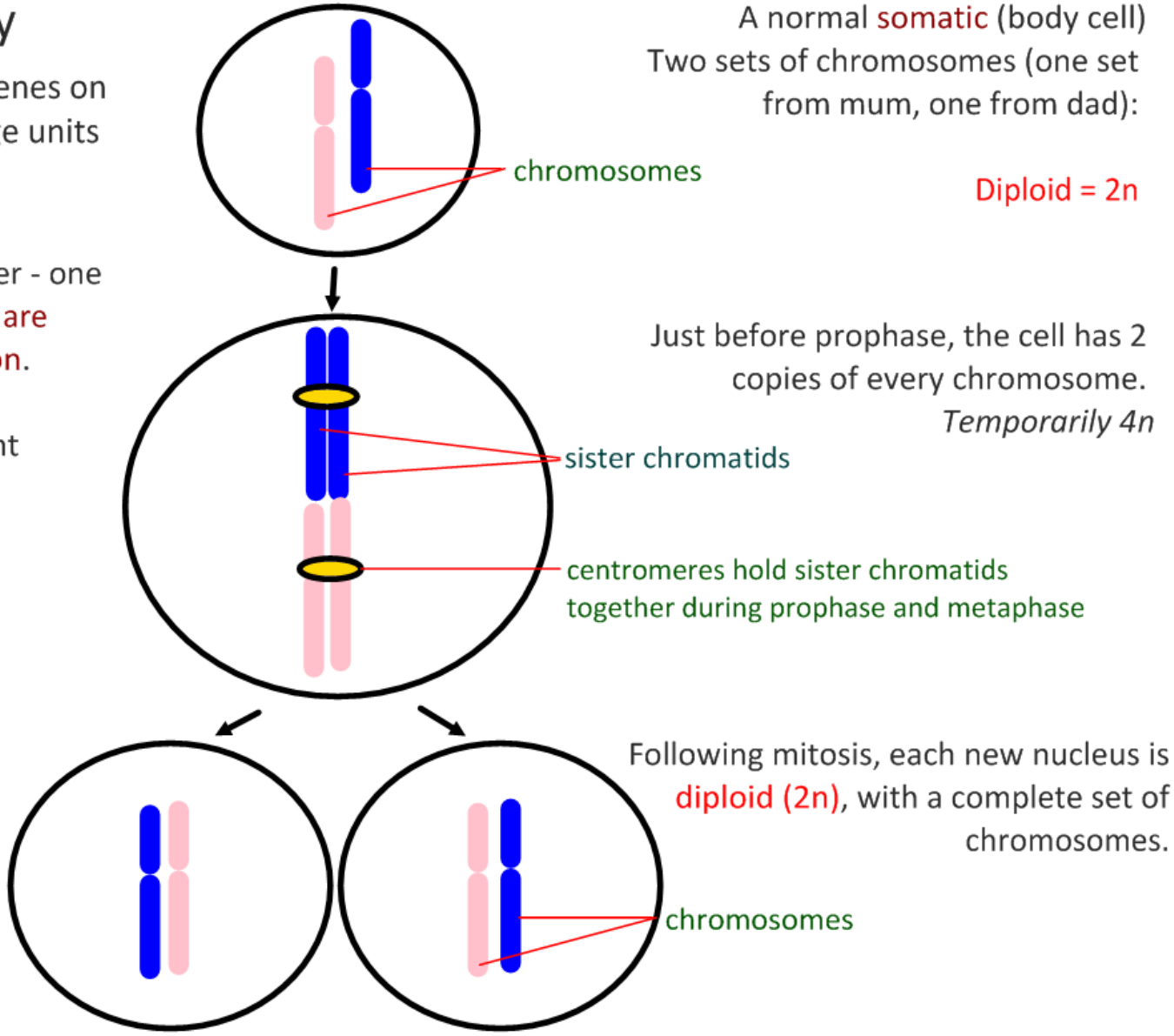
Each chromosome has a partner - one from each parent. Both copies are required for the cell to function.

Different species have different chromosome numbers:

Humans = 23 pairs (n=23)
∴ diploid number (2n) = 46

Frogs = 13 pairs (n= 13)
Corn = 10 pairs (n=10)
Dogs = 39 pairs (n=39)

Gametes (sex cells - sperm and eggs) are haploid (n). They have a half set, as they will pair up with the other half in fertilisation.



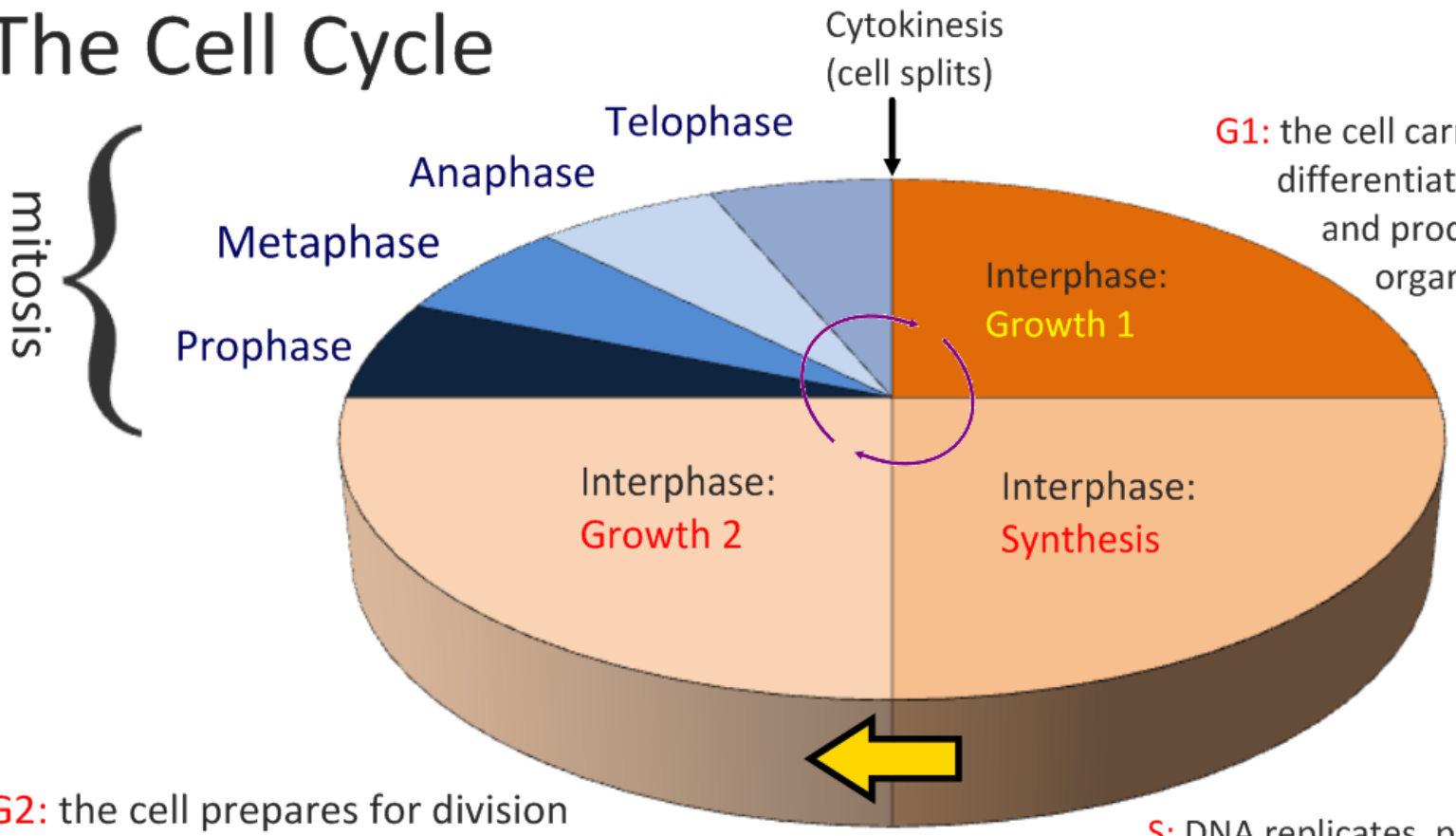
A normal somatic (body cell)
Two sets of chromosomes (one set from mum, one from dad):

Diploid = 2n

Just before prophase, the cell has 2 copies of every chromosome.
Temporarily 4n

Following mitosis, each new nucleus is diploid (2n), with a complete set of chromosomes.

The Cell Cycle



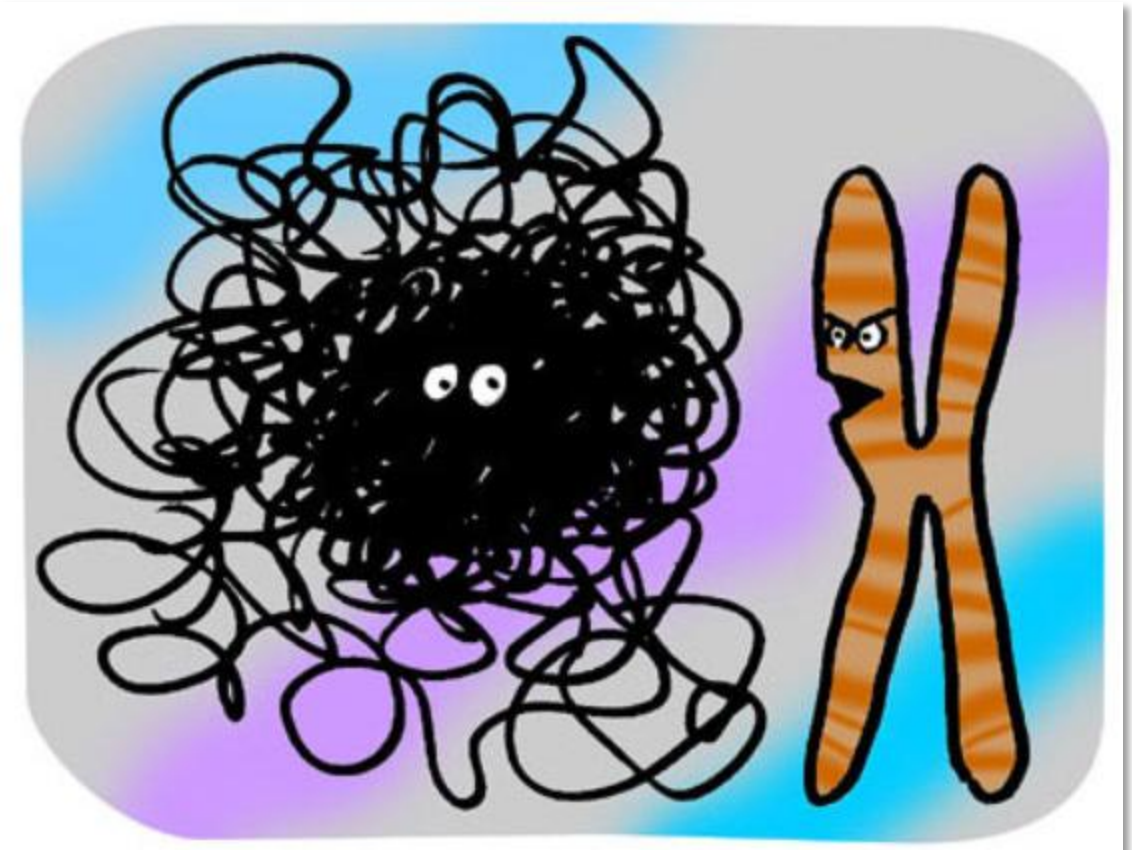
G1: the cell carries out its differentiated function and produces more organelles.

G2: the cell prepares for division

S: DNA replicates, producing a copy of each chromosome - this is so that each daughter cell has the right number of chromosomes.

Interphase is the phase in which the cell spends most of its time. It is when the cell carries out its differentiated function and is sub-divided into 3 stages - G1, S and G2.

Proteins and DNA are synthesised in interphase, and more organelles, such as mitochondria and chloroplasts, are produced.



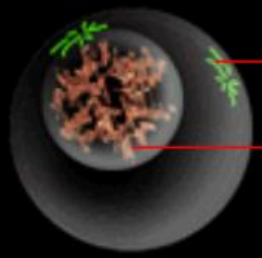
Dude, mitosis starts in five minutes...
I can't believe you're not condensed yet.

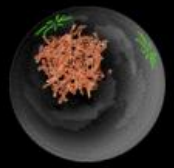
http://www.promega.com/

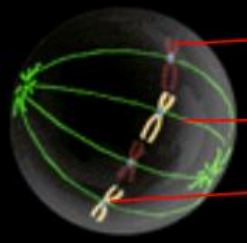
http://www.bio.miami.edu/~cmallery/150/mitosis/mitosis.cartoon.jpg

Mitosis

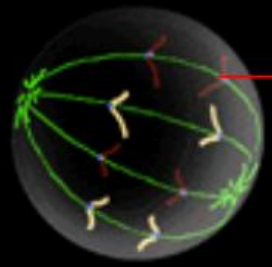
Mitosis is the division of the nucleus, not the cell.



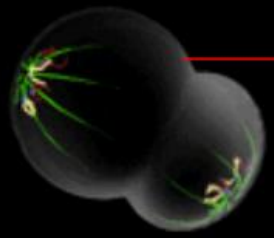




Can you write a short paragraph using these key terms to describe the process of mitosis?



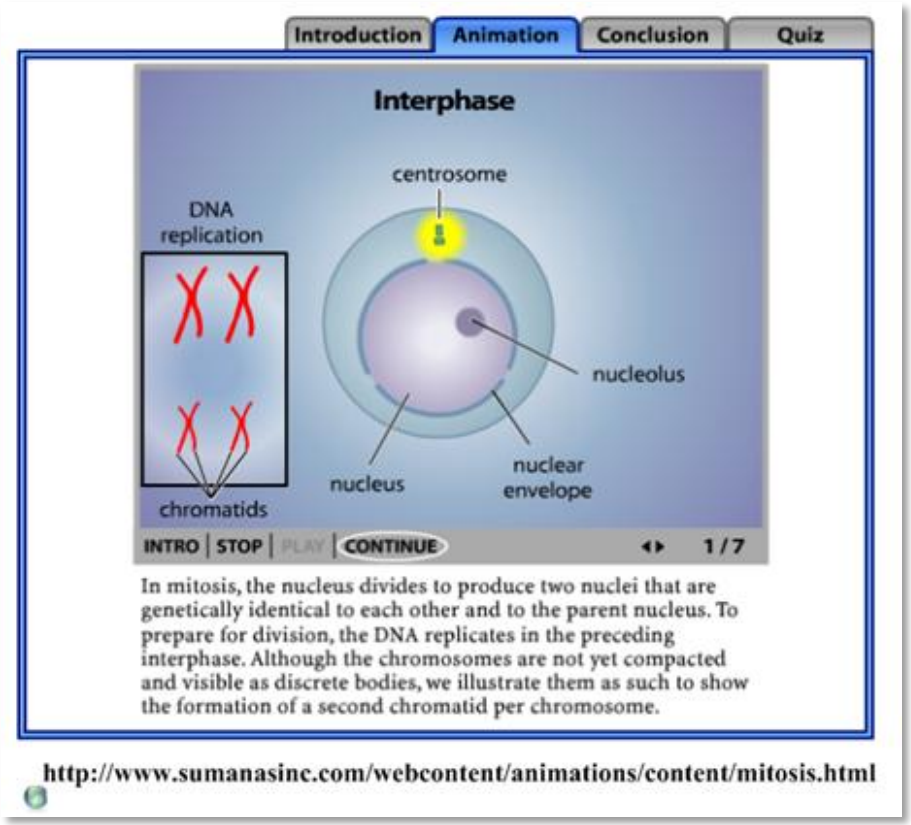
What is the difference between a chromosome and a chromatid?

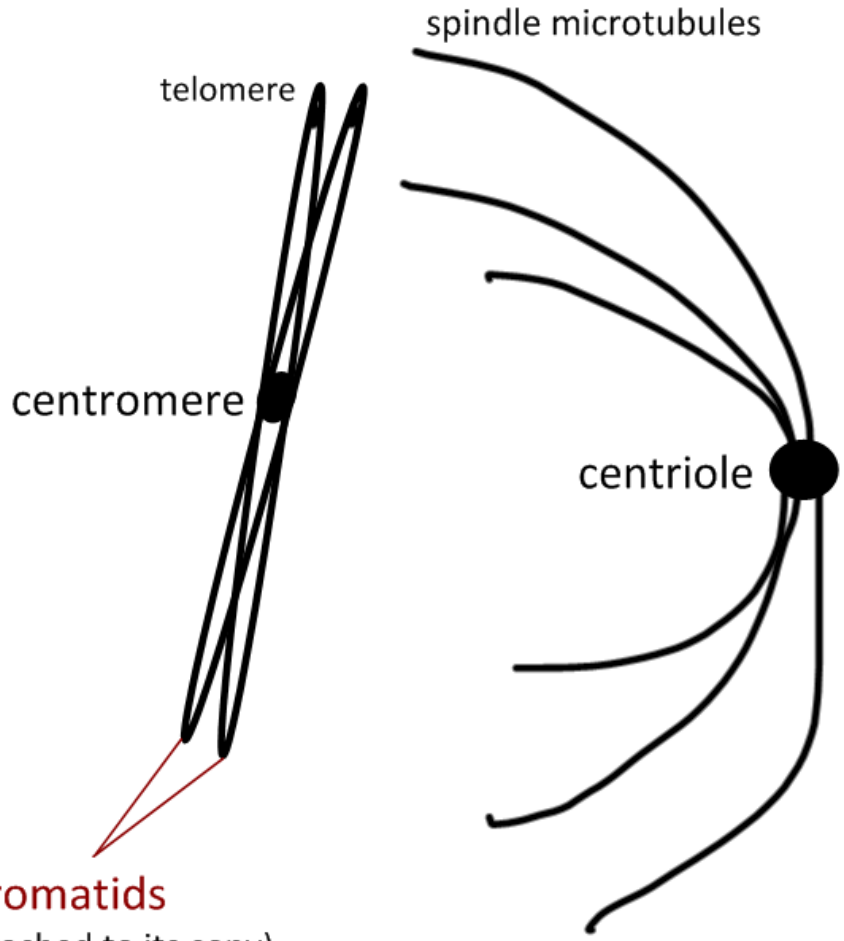


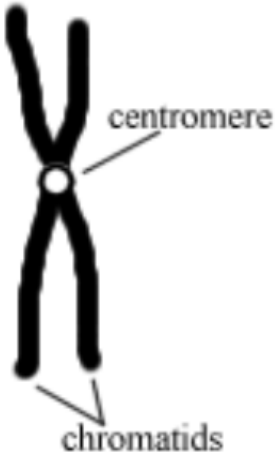
How does mitosis ensure that the daughter cells are gentically identical?

http://www.biology.arizona.edu/cell_bio/cell_bio.html

Take care with the terminology!





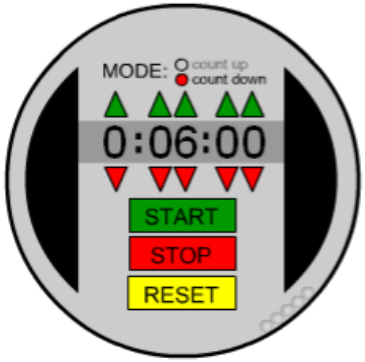


sister chromatids

(a chromosome attached to its copy)

Exam Question:

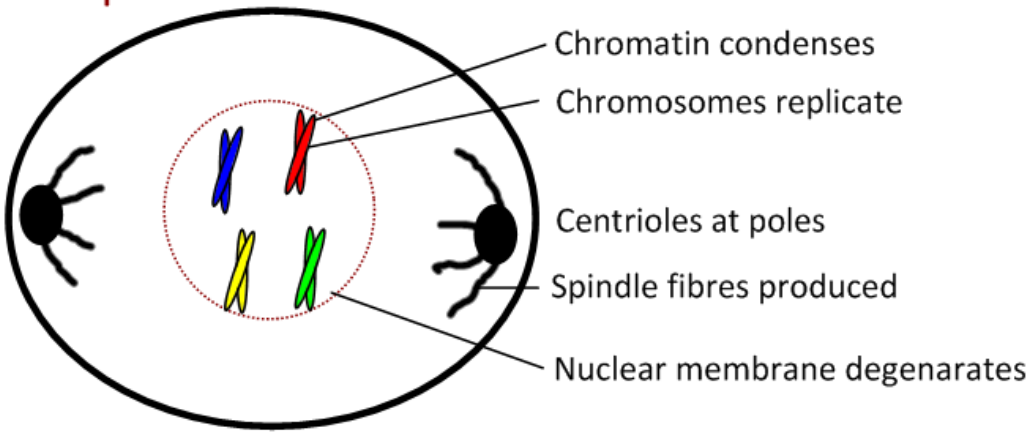
Draw labelled diagrams of the four stages of mitosis in an animal cell with four chromosomes (5 marks)



Exam Question: Draw labelled diagrams of the four stages of mitosis in an animal cell with four chromosomes (5 marks)

The four diagrams must have the name of the phase, otherwise award [3 max]. The four stages must be included to receive [5]. If correct number of chromosomes is not shown award [4 max].

1. Prophase



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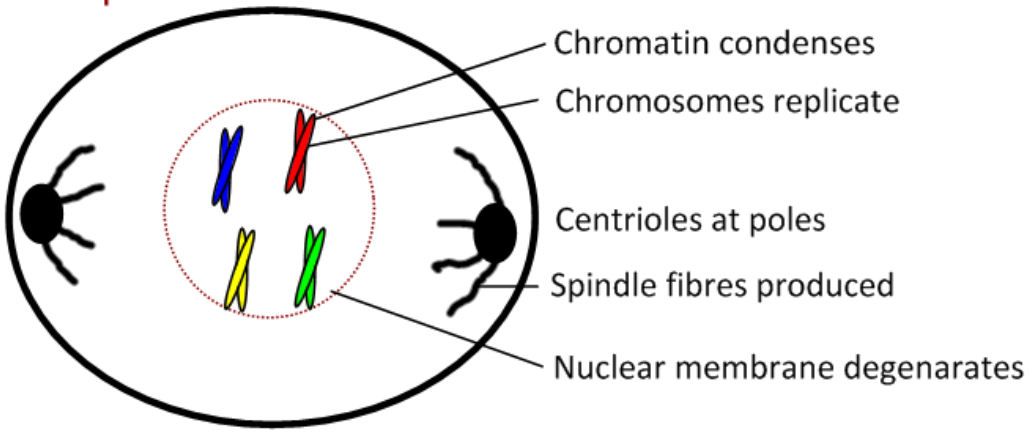
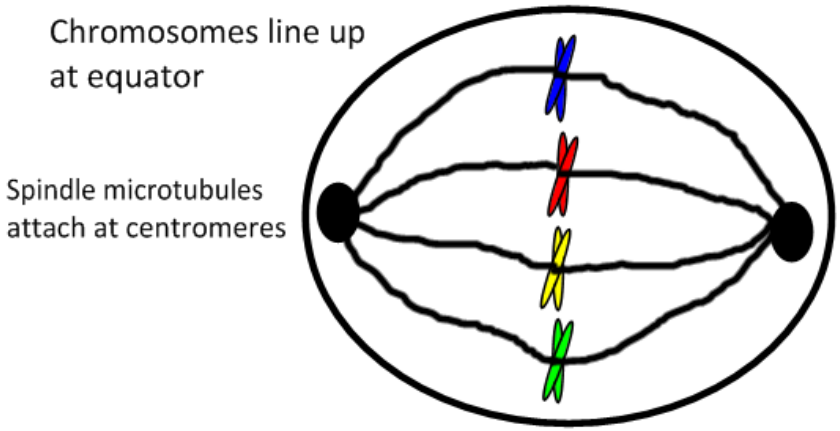


2. Metaphase



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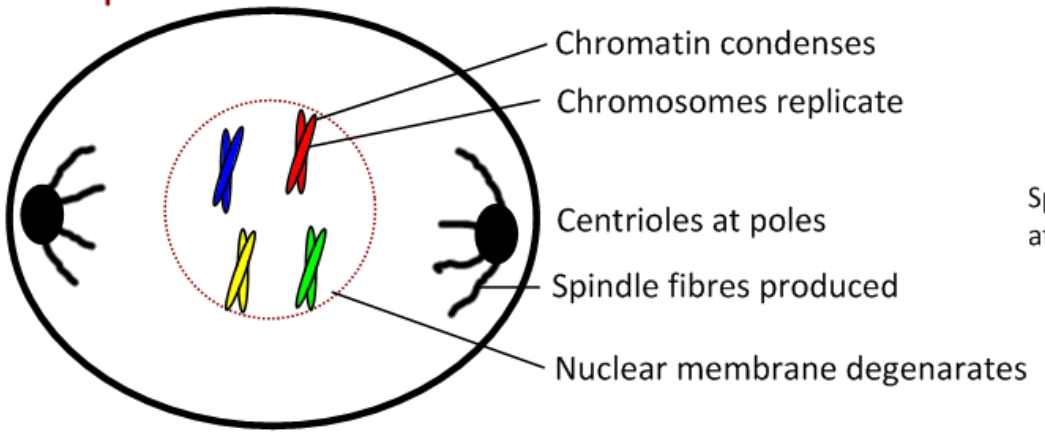
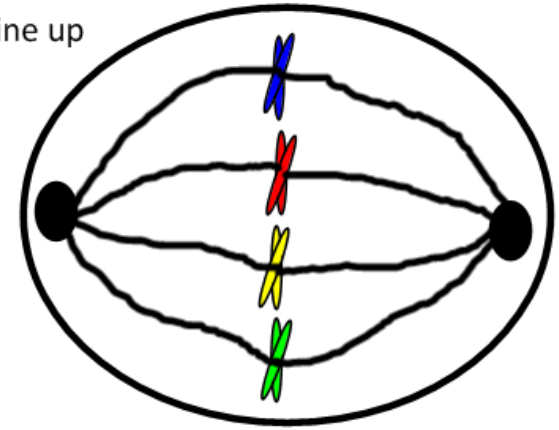


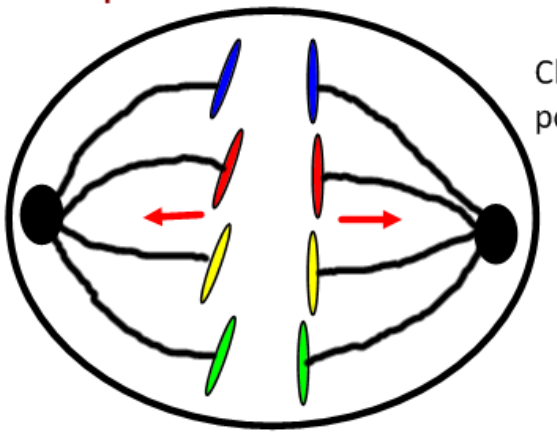
2. Metaphase

Chromosomes line up at equator

Spindle microtubules attach at centromeres



3. Anaphase



Chromatids pulled to poles by spindle fibres

Exam Question: Draw labelled diagrams of the four stages of mitosis in an animal cell with four chromosomes (5 marks)

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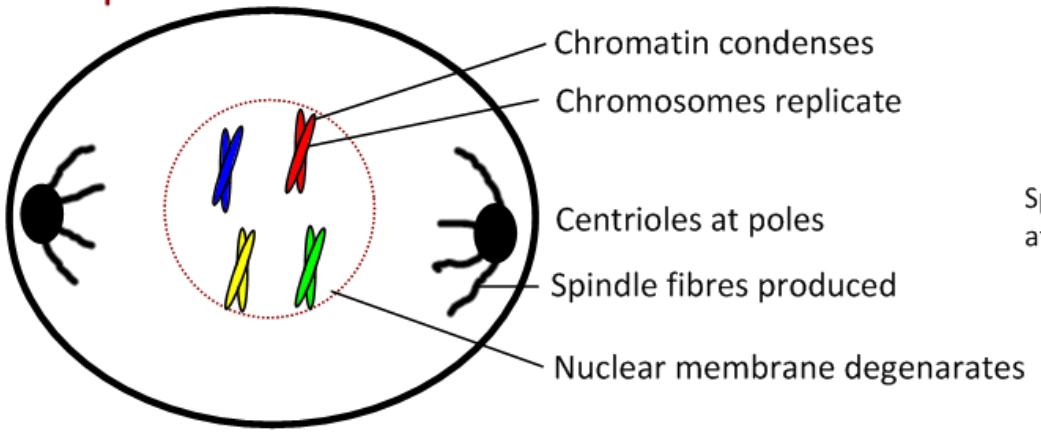

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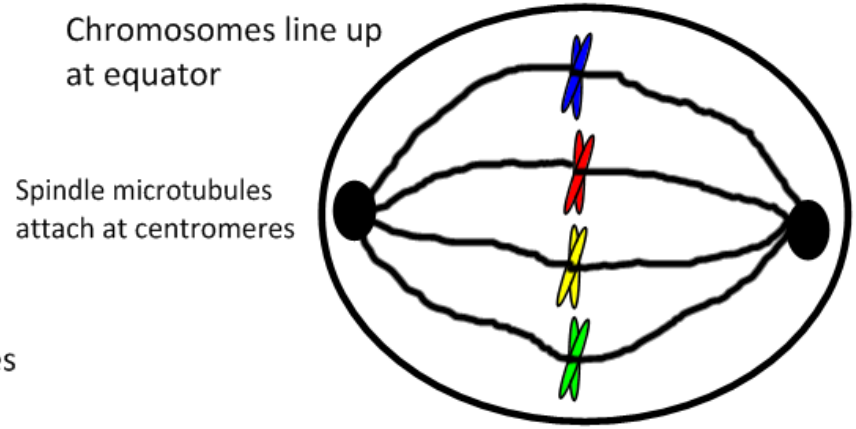

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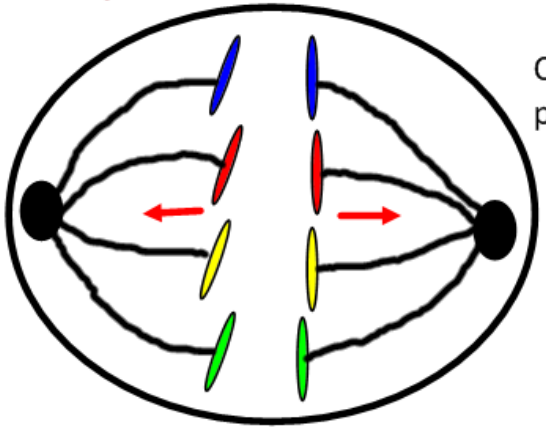
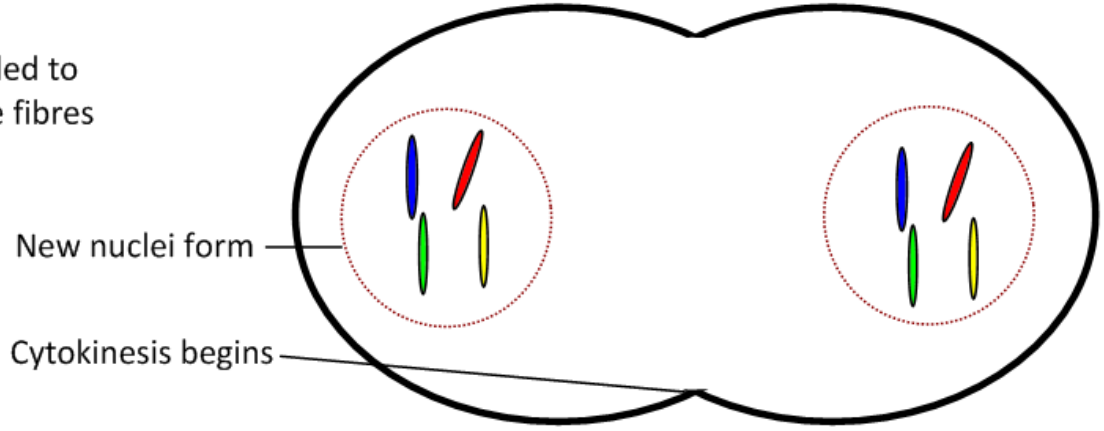
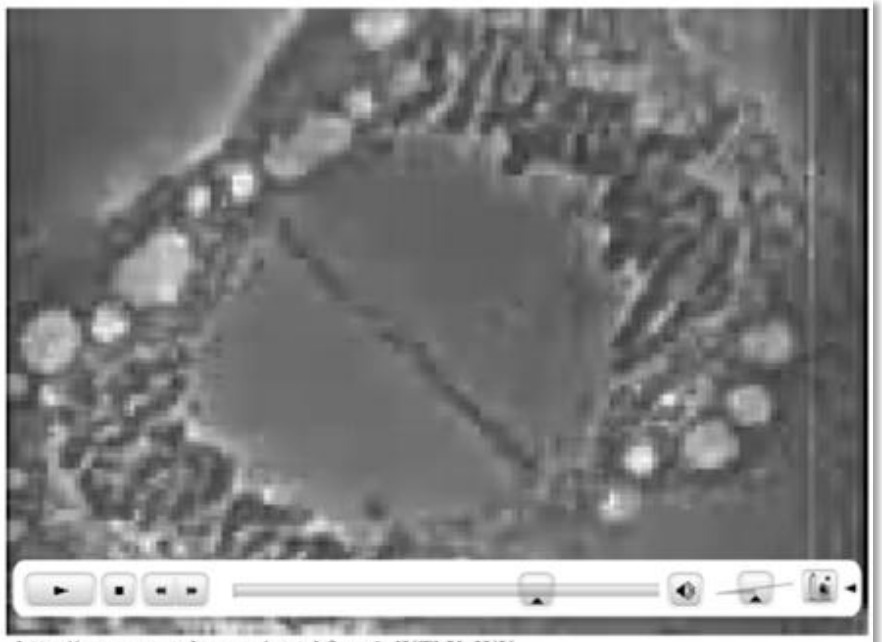


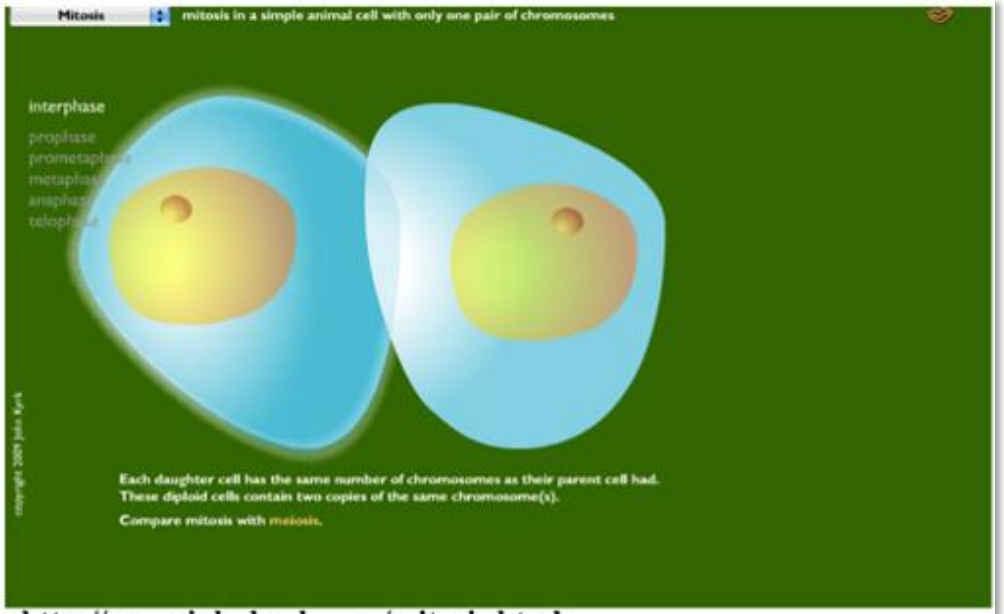
4. Telophase



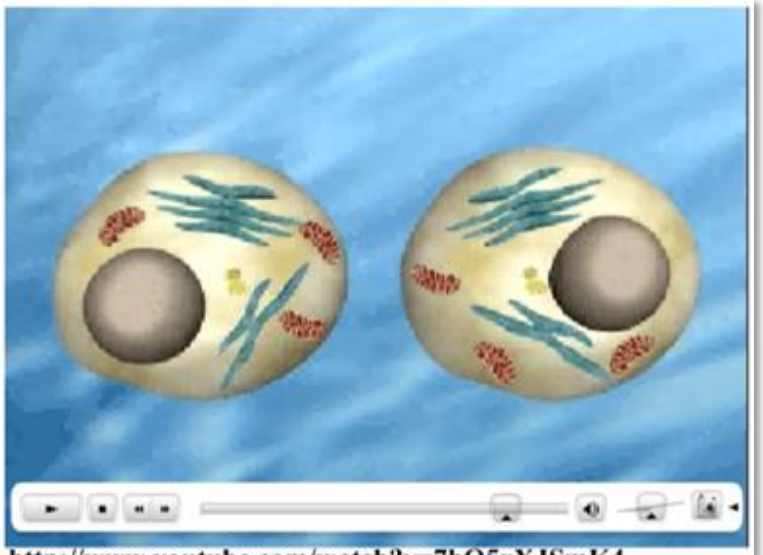
More about the stages of mitosis:



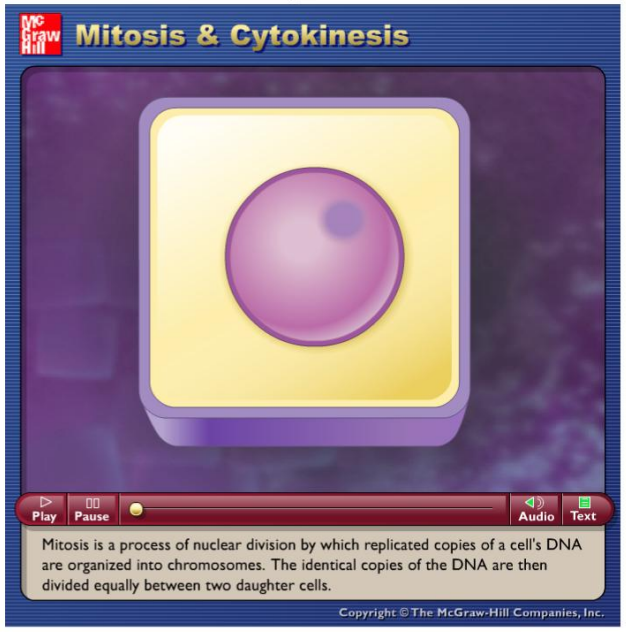
http://www.youtube.com/watch?v=s1ylUTbXyWU



http://www.johnkyrk.com/mitosis.html



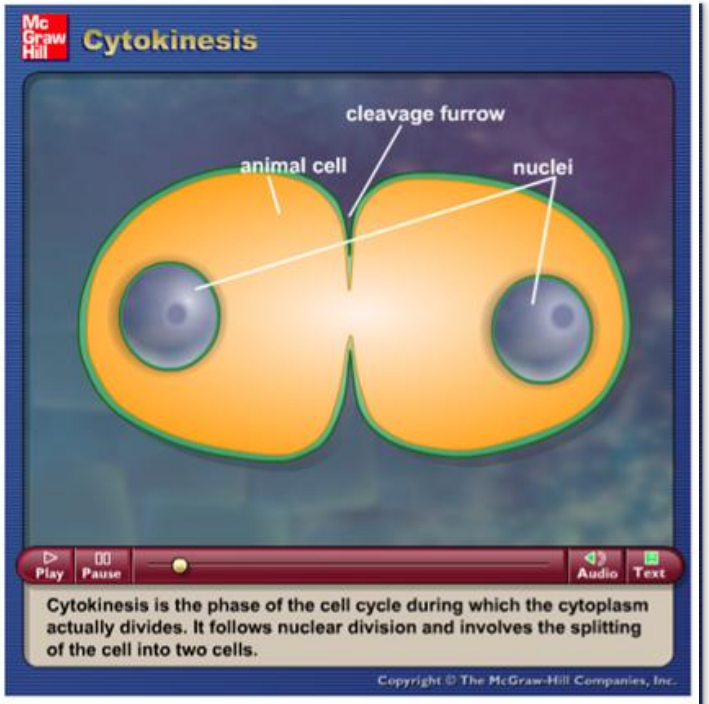
http://www.youtube.com/watch?v=7hQ5xXJSmK4



http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter2/animation__mitosis_and_cytokinesis.html

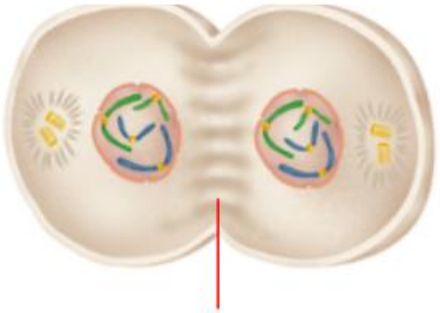
http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter2/animation__mitosis_and_cytokinesis.html

Cytokinesis is the moment when the cell divides into two daughter cells:

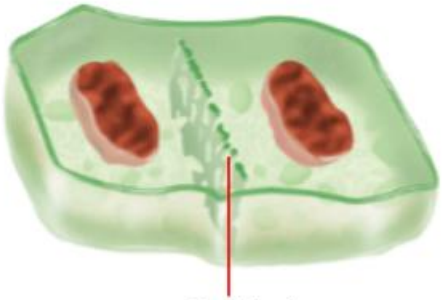


http://glencoe.mcgraw-hill.com/sites/9834092339/student_view0/chapter10/animation_-_cytokinesis.html

How is cytokinesis different in plant and animal cells?



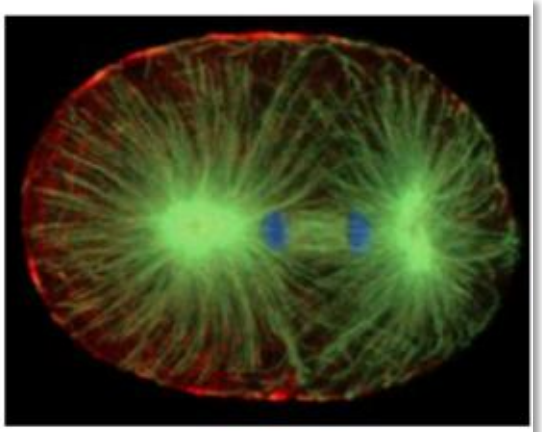
protein threads form along the equator of the cell, paving the way for the plasma membrane to form.



a cell plate is formed along the middle of the cell, allowing the cell wall to cleave the cell in two.

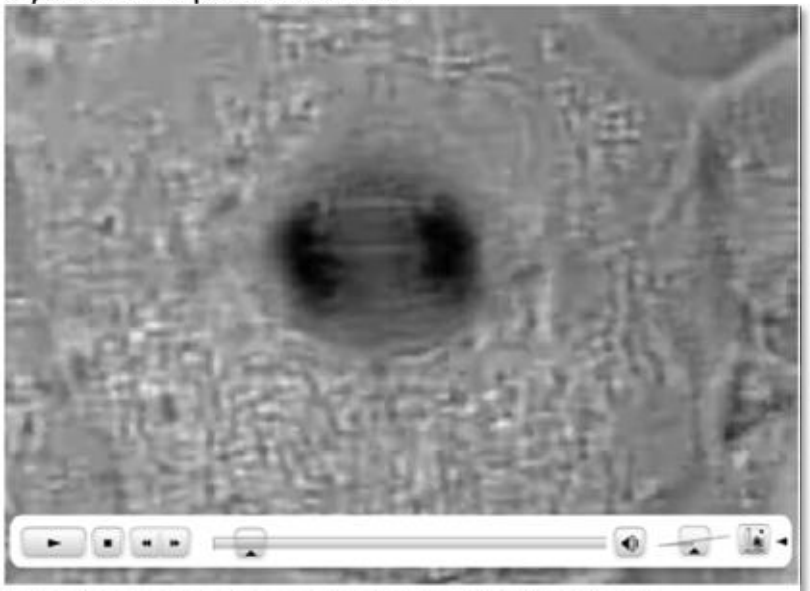
image source unknown

Read the article on the recent discovery of the methods of cytokinesis here:



http://www.sciencedaily.com/releases/2008/12/081204141753.htm

Cytokinesis puzzle solved:



http://www.youtube.com/watch?v=KE2VI7tDL1k

How does mitosis ensure the daughter cells are genetically identical?

Exact copies of DNA are made in interphase S-phase.
DNA replication includes checks to make sure mistakes are not made.
DNA is supercoiled (condensed), keeping it all together.

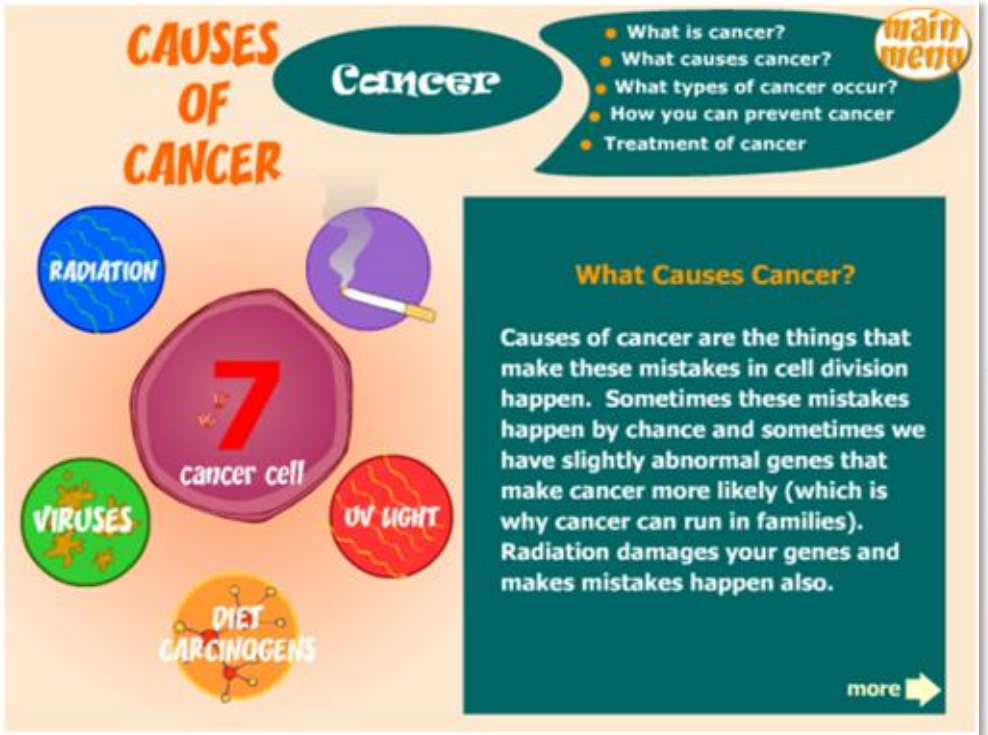
In metaphase, all sister chromatids line up at the equator.
When the spindle microtubules attach to the centromeres, they are in the correct position - one copy facing each pole of the cell.

In anaphase, these chromatids are pulled apart - exactly the right number are pulled in each direction.

At telophase, the chromosomes have reached the poles.
There is a clear space between the newly-forming nuclei to allow the cell to divide by cytokinesis, ensuring no chromosomes are caught on the wrong side.

Tumours are the result of uncontrolled cell division

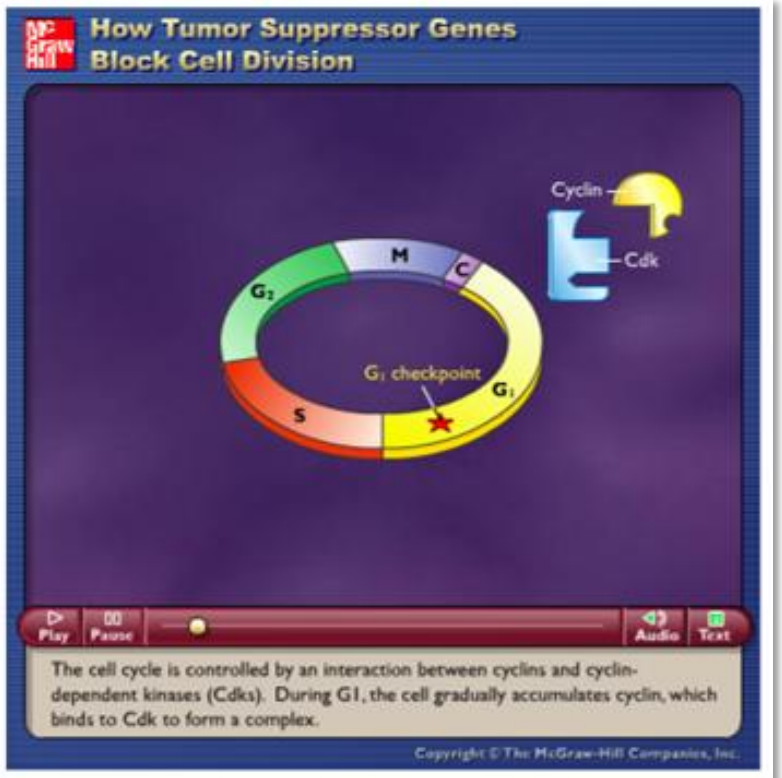
Cancer made simple:



http://www.e-learningforkids.org/Courses/Liquid_Animation/Conditions_Diseases/Cancer/cancer_object.swf

A tumour is simply the proliferation of cells - the genetic checks that stop them reproducing fail to work and cells grow out of control.

Tumours can occur in any organ or tissue, though are most common after exposure to carcinogens (e.g. tobacco smoke) or in particularly active tissues (e.g. breast, skin and cervical tissues).



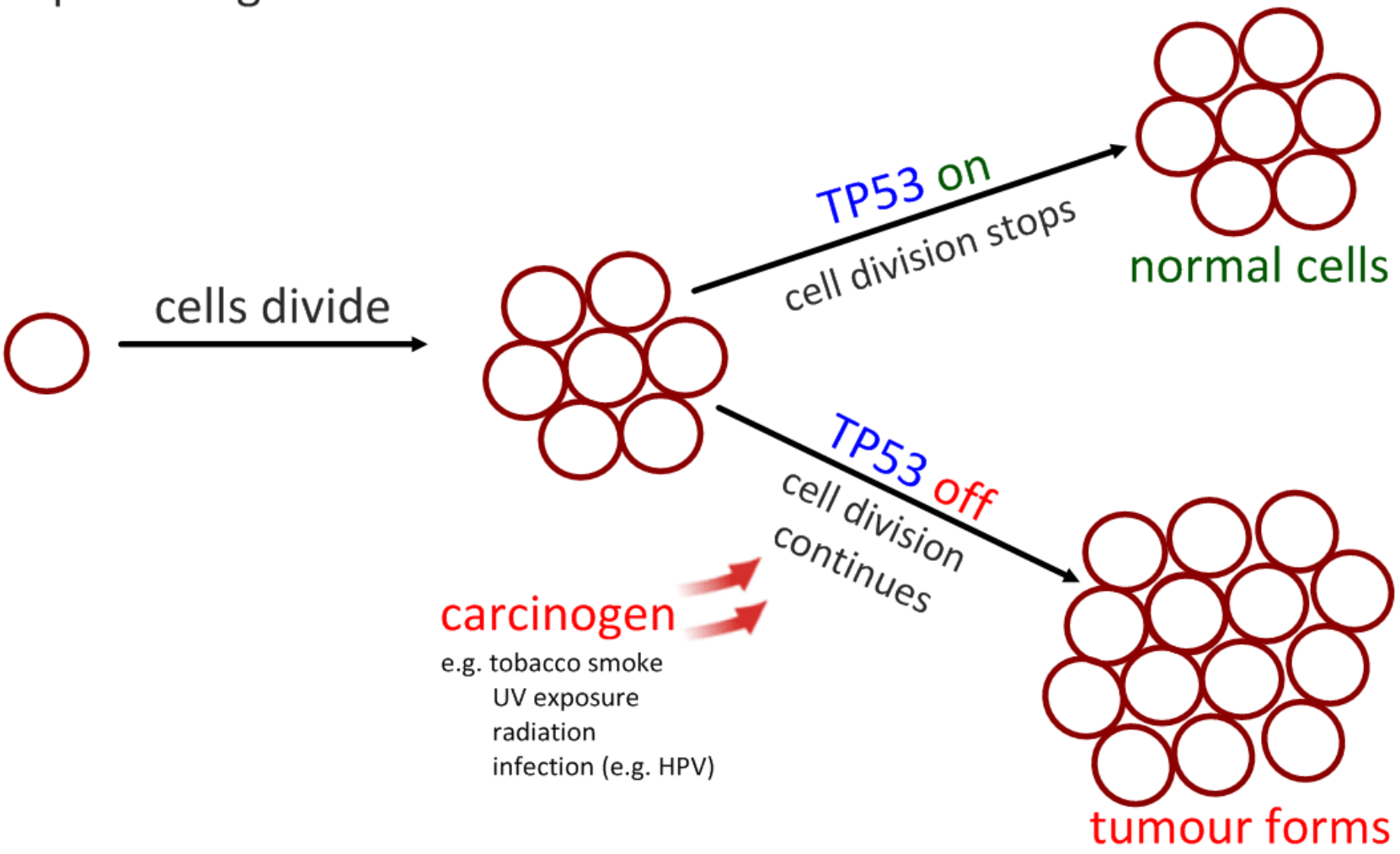
http://highered.mcgraw-hill.com/olc/dl/120082/bio34b.swf

NATIONAL CANCER INSTITUTE

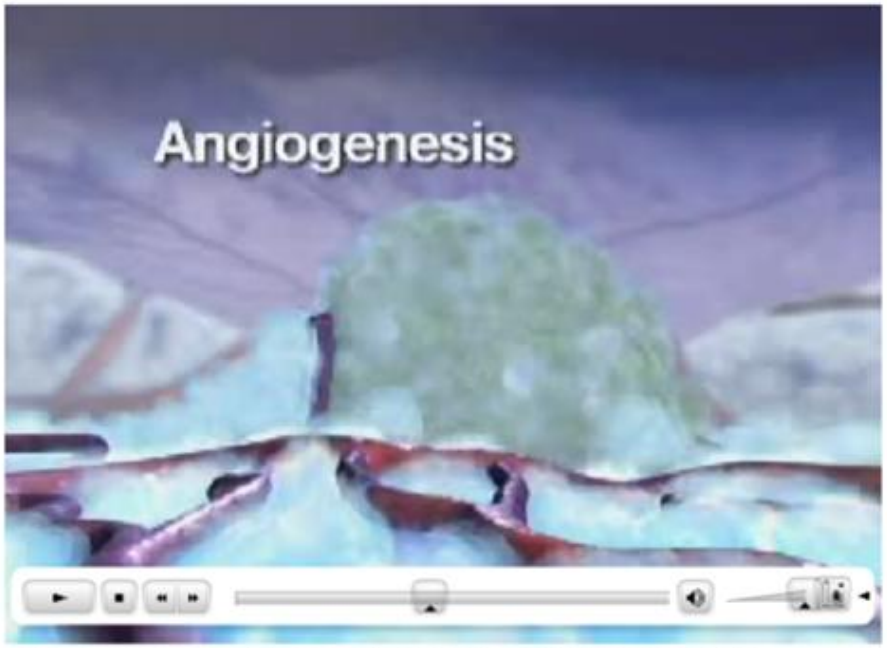
Be aware: find out more here

http://www.cancer.gov/cancertopics/commoncancers

Carcinogens can cause mutations in a gene which tells the cell to stop dividing:



How do cancers spread and cause death?



http://www.youtube.com/watch?v=aKBZbxBnpGM

Tumour: cell mass from uncontrolled division

Angiogenesis: tumour recruits blood vessels and grows larger

Metastasis: part of the tumour invades the blood vessel, travels through the blood and starts to form a tumour in another part of the body.

http://www.youtube.com/watch?v=acUl9JC70e8

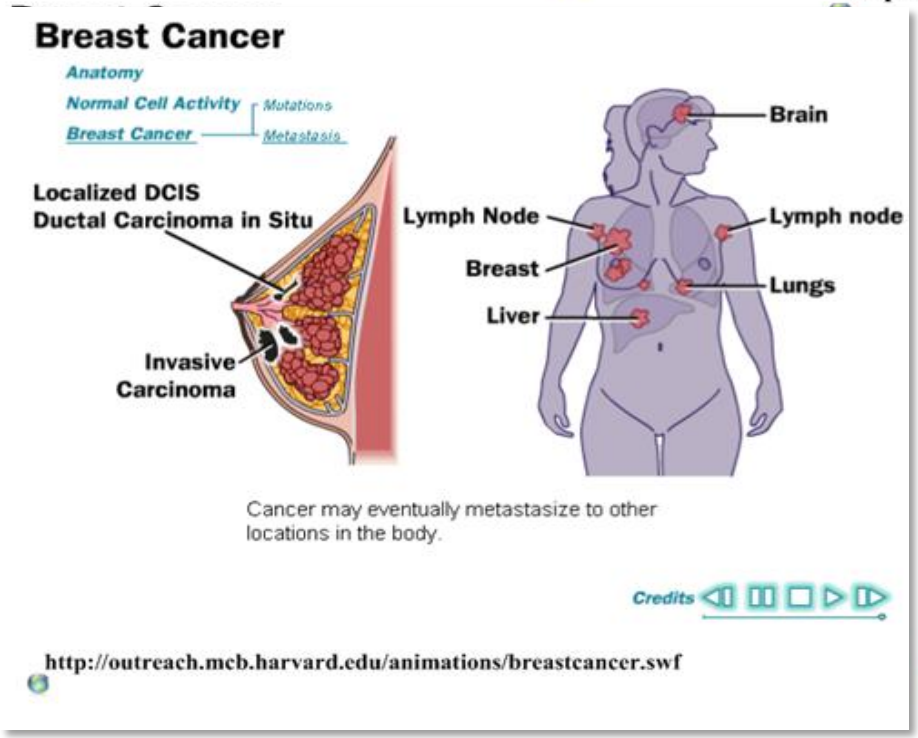
Cancer can result in the death of healthy, otherwise functional tissues.

Eventually, these functions are so compromised that it can lead to death.

Resources for the girls:

Late October, each year

http://www.pinkribbonday.com.au/Home.htm



http://outreach.mcb.harvard.edu/animations/breastcancer.swf

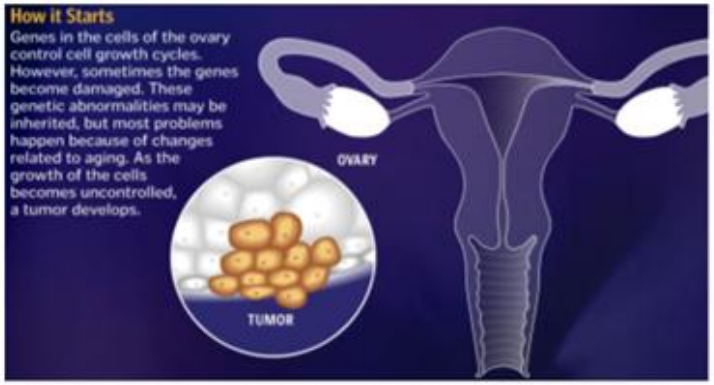
Cervical cancer:

http://hcd2.bupa.co.uk/fact_sheets/html/cervical_cancer.html

Animation:

http://health.discovery.com/centers/cancer/cancermain/interactive/media/cervicalcancer.swf

Ovarian cancer:

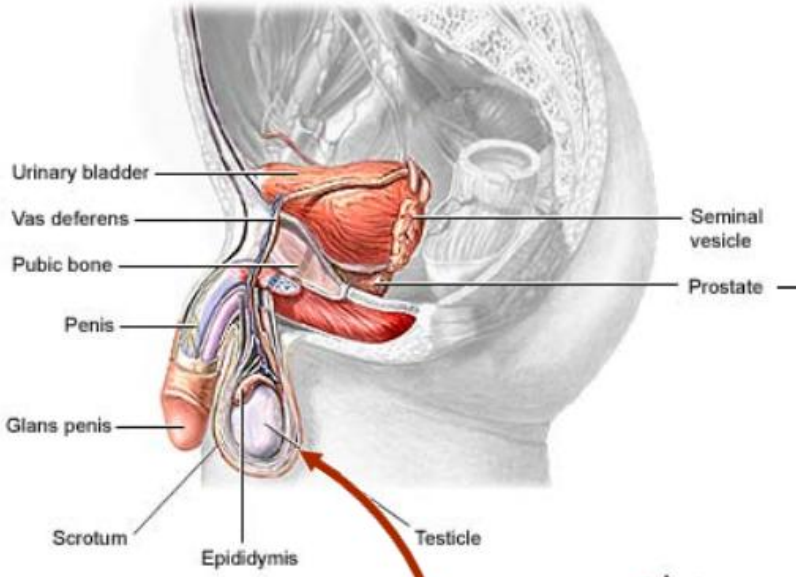


http://health.discovery.com/centers/cancer/cancermain/interactive/media/ovariancancer.swf

Uterine cancer:

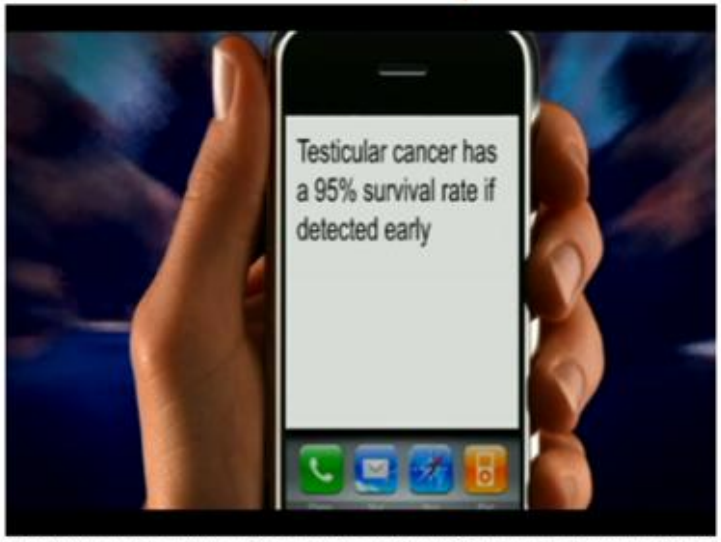
http://www.cancercenter.mobi/video/cancer-types/medanim/uterinecancer.cfm

Resources for the boys:



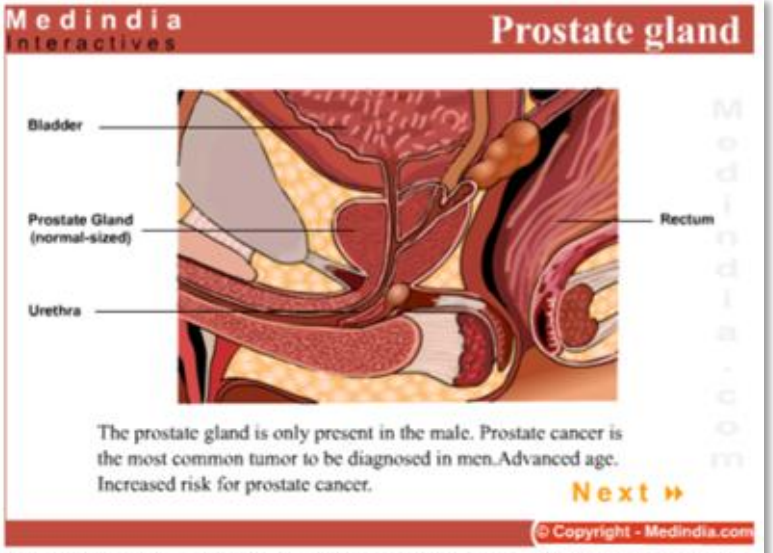
ADAM.

Testicular cancer:

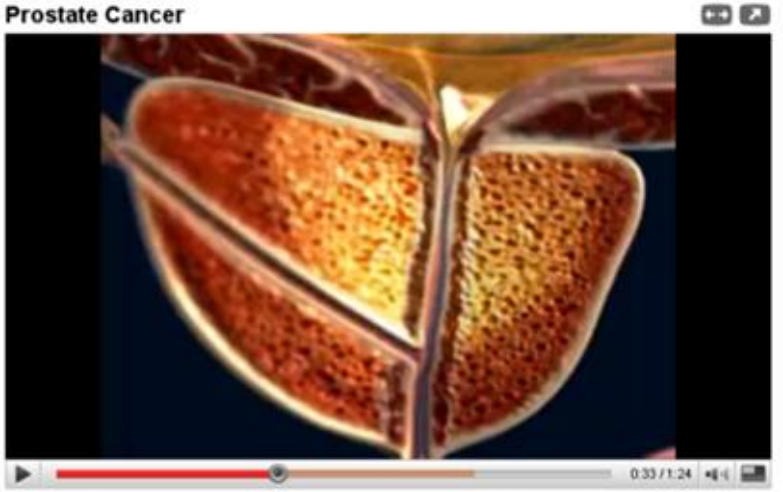


http://www.seankimerling.org/index.php/blog/110-new-3d-animation-demonstrating-the-proper-way-to-do-a-tse-now-available-from-the-sean-kimerling-testicular-cancer-foundation

Prostate cancer:



http://www.medindia.net/animation/Prostate_Cancer.asp



http://www.youtube.com/watch?v=7YA1fumPaf0

ADAM male reproductive system source:
http://www.health-res.com/EX/07-28-21/adam-male-reproductive-system.jpg

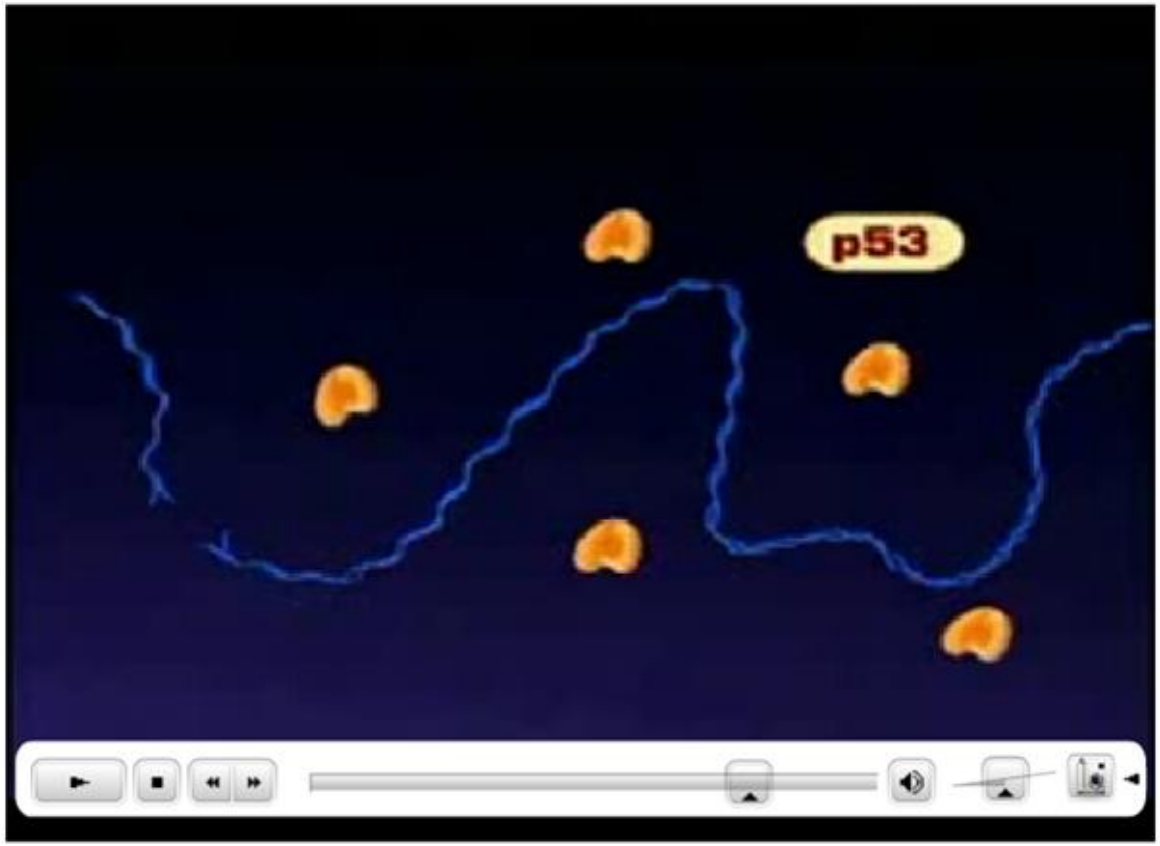
It's too late to apoptise...

If you can understand all of this, you need to be in HL.

Apoptosis = programmed cell death

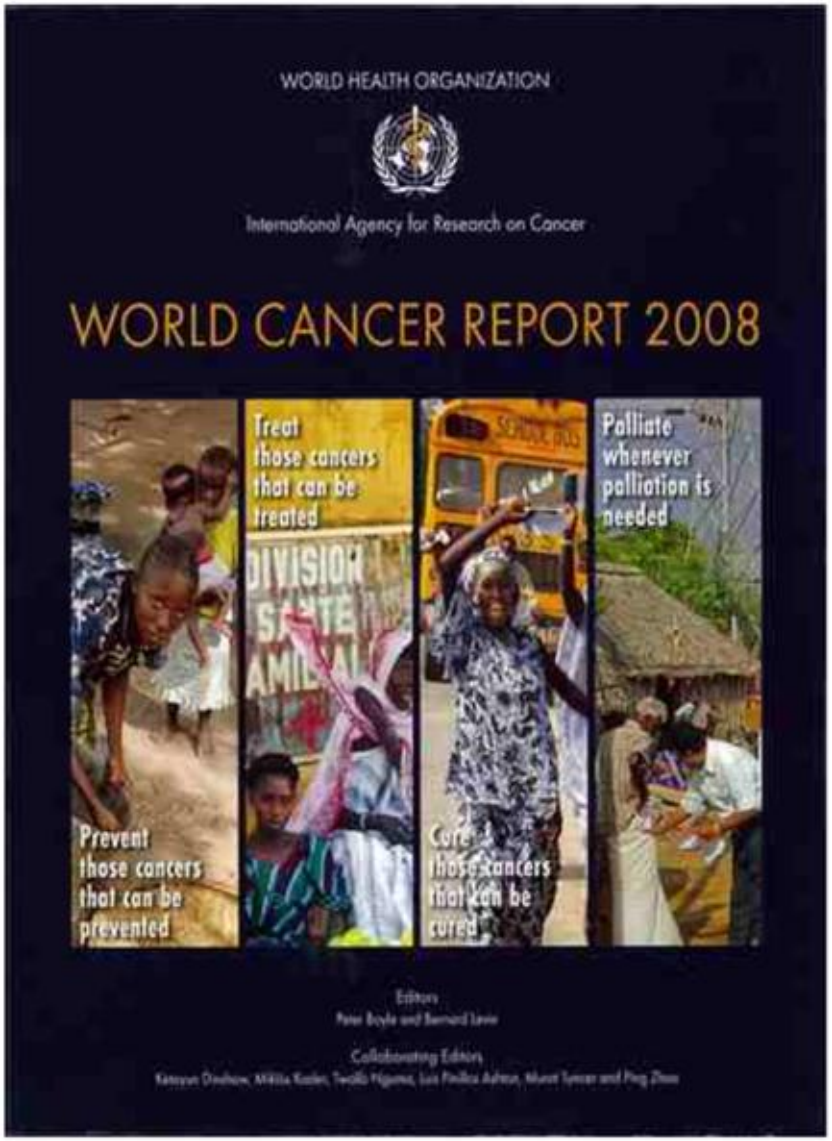
Tumours arise when cells don't die when they should!

http://www.youtube.com/watch?v=qjjHKDn12qI

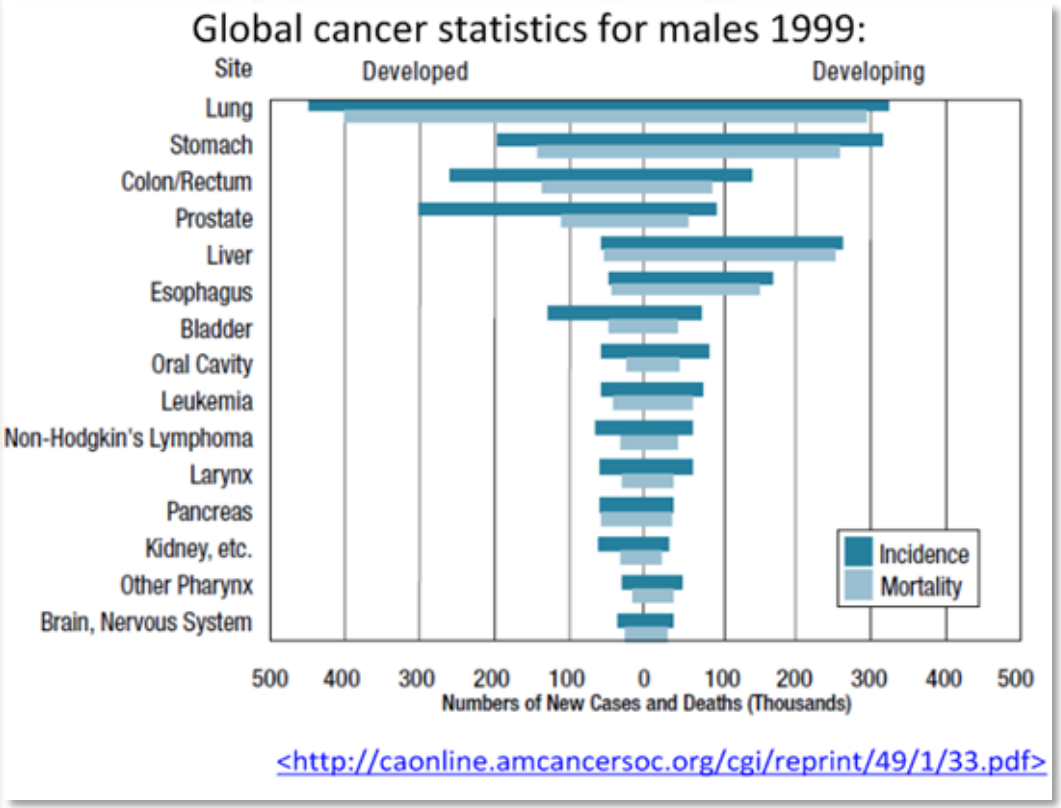


Subtitles at:
http://www.youtube.com/watch?v=mHOX43-4PvE&NR=1

Can you write lyrics that sum up the following:
- stem cells and division?
- tumour formation?



http://apps.who.int/bookorders/anglais/detart1.jsp?sesslan=1&codlan=1&codcol=76&codcch=26#



<http://caonline.amcancersoc.org/cgi/reprint/49/1/33.pdf>

What are the world's biggest killers?
Can they be prevented?
Is treatment available equally to all?

DOCTOR FUN presents BLOBS

blobs-001

"And that concludes today's lecture demonstration of mitosis."

For more IB Biology resources:

http://sciencevideos.wordpress.com