كلية العلوم

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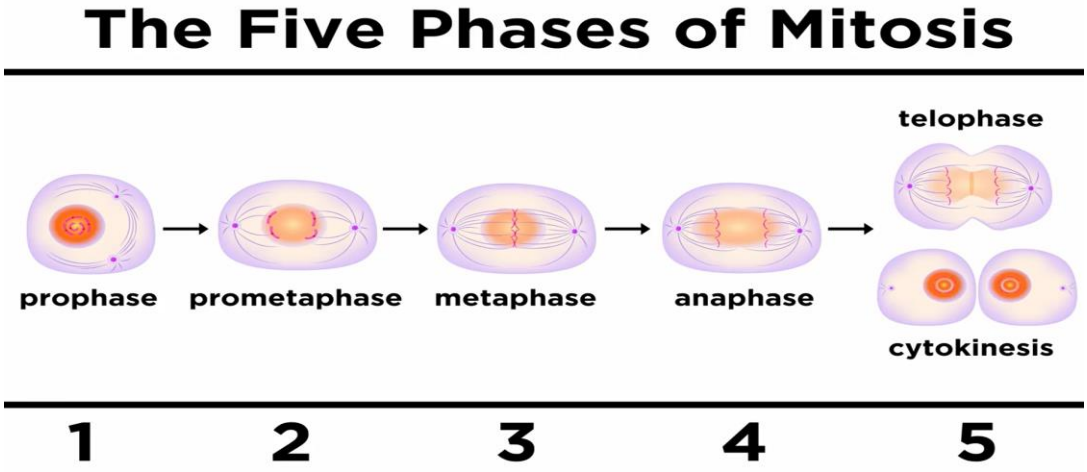
Mitosis- How One Cell Becomes Two

The actual process of cell division, which is called mitosis, is happening all over your body right now, and it's quite complex, so let's take a look at how this works.

Mitosis is divided into five phases

There's the prophase, prometaphase, metaphase, anaphase, and telophase.

At the completion of telophase, there is also cytokinesis.



Once all this is finished, we end up with two identical cells, each with all the genetic information pertaining to that organism.

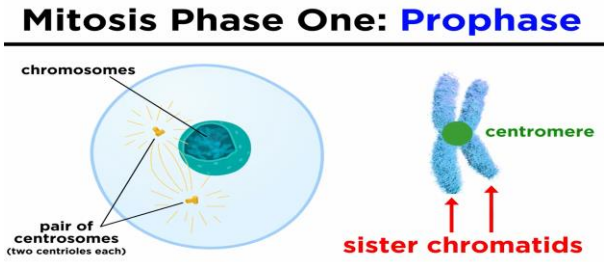
But let's start at the beginning and learn what happens in each phase

Before mitosis begins, when the cell is still in the G2 phase of the cell cycle, we have two copies of all the chromosomes sitting in the nucleus, but they are loose and strewn about.

In addition, the centrosome of the cell, which as we recall, contains two centrioles, has duplicated, so there are two pairs of centrioles.

The Prophase

Then, as mitosis begins, during the prophase, the chromatin becomes tightly coiled, and forms the shape we are familiar with for chromosomes, with sister chromatids linked by a centromere.



It is also in the prophase that something called the mitotic spindle begins to form. This is made up of the two centrosomes and a number of microtubules that begin to form between them.

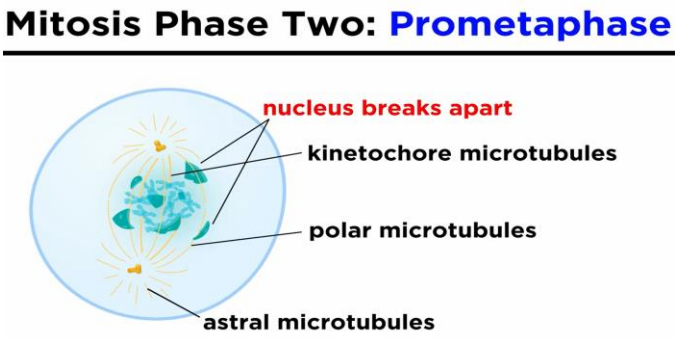
Each centrosome also has a radial array of microtubules surrounding it called an aster.

As the cytoskeleton disassembles, the microtubules between the centrosomes grow and grow, which pushes them apart.

The Prometaphase

Then, in the prometaphase, the nucleus breaks apart and the growing microtubules cover the area where the nucleus used to be, so that they can attach to special proteins called kinetochores, which have assembled on the chromosomes at their centromeres.

Things are starting to get organized as a kind of tug of war plays out.



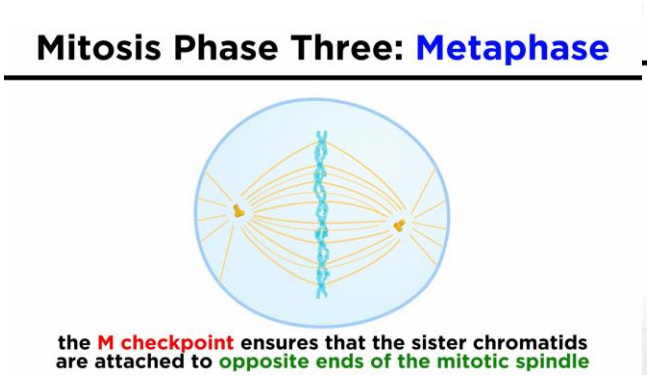
The Metaphase

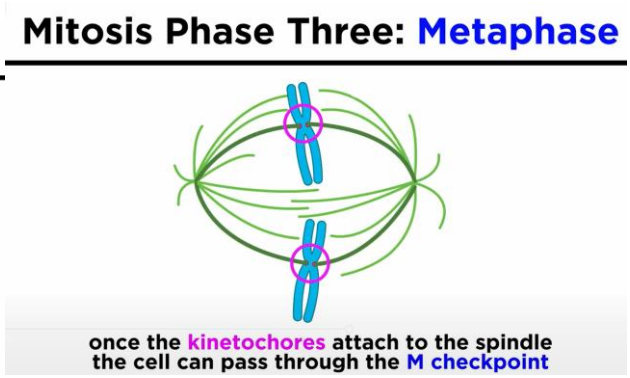
Then in the metaphase, the centrosomes have settled at the poles of the cell with the asters attaching to the plasma membrane, and all of the chromosomes have been arranged nicely along a plane in the middle of the cell.

This imaginary plane is called the metaphase plate.

At this stage, there is a checkpoint to ensure that each pair of sister chromatids is firmly attached to opposite ends of the mitotic spindle.

Once all the kinetochores are attached to the spindle and everything is lined up nicely, a regulatory protein complex becomes activated, allowing the cell to pass through the M checkpoint, which means we are ready for the anaphase.



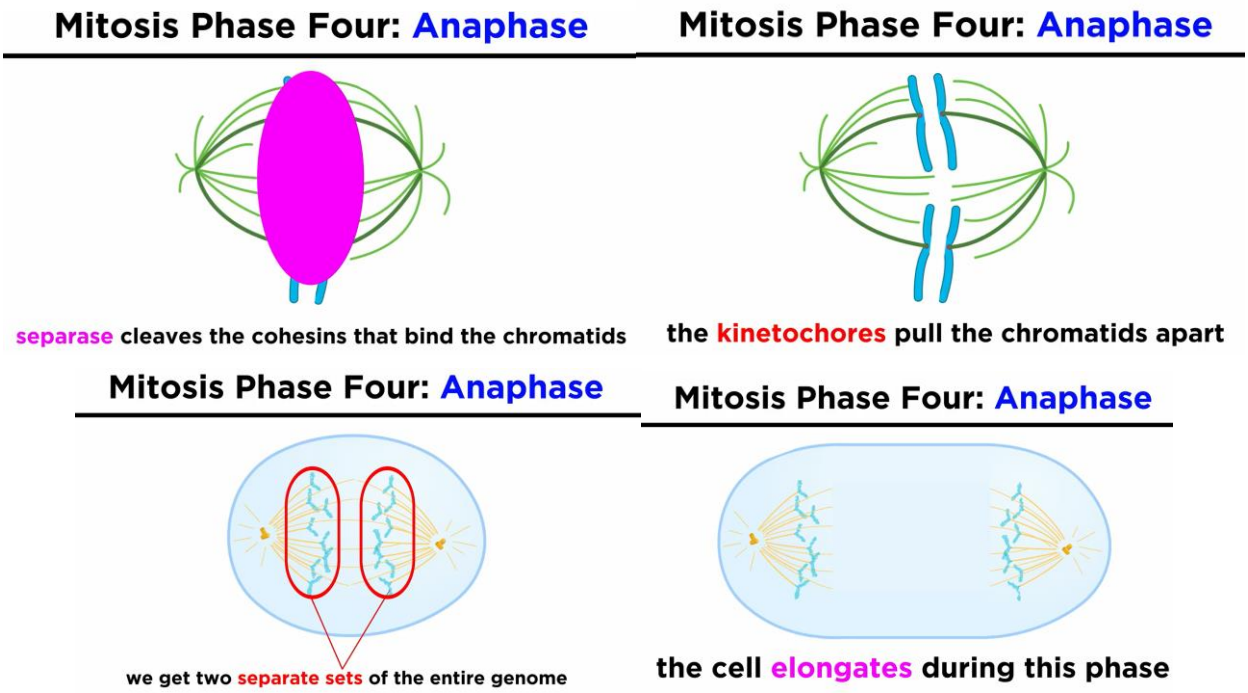


The Anaphase

In this phase, the shortest of all the phases, the enzyme separase cleaves the cohesins that keep the sister chromatids together, and the kinetochores attached to the two sister chromatids pull the chromatids apart on each chromosome, thus generating the two separate sets of the genome.

These chromosomes are then pulled by motor proteins that attach to the kinetochores, which reel them in by their centromeres to opposite ends of the cell, with the microtubules they are attached to coming apart as they go.

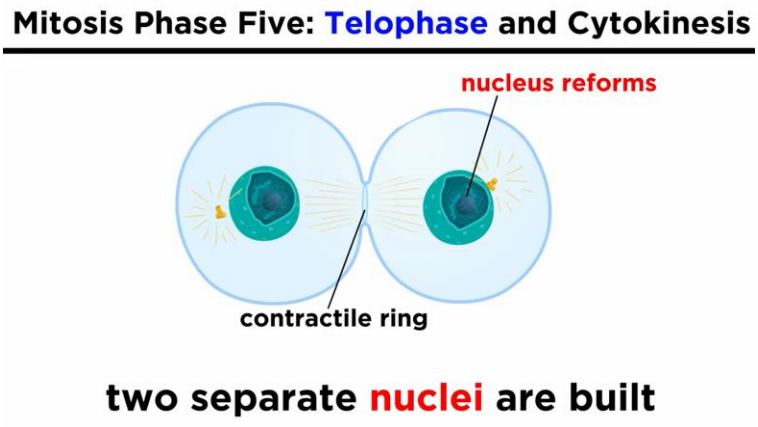
The cell also elongates during this phase, until the two sets of chromosomes are far apart.



The Telophase

Then in the telophase, two new nuclei form, rebuilt from the fragments of the original nucleus that came apart in the prometaphase.

The chromosomes loosen up a little, the microtubules finish coming apart, and mitosis is complete, with two genetically identical nuclei.



To finish things up, cytokinesis will occur, which is where the cytoplasm, which has already begun dividing the cell into two smaller ones, will continue until the cells are distinct and separate.

This starts with a cleavage furrow at the metaphase plate, caused by actin microfilaments that pull the cell inwards like a drawstring, which eventually pinches the cell in two.

Your body is constantly producing new cells by mitosis, to make new skin, heal a wound, or when you grow rapidly in childhood.

Every single somatic cell in your body was produced by mitosis, except the very first one.

This first cell is an egg cell that has been fertilized by a sperm cell, and these reproductive cells, or gametes, are produced by a different process, so let's learn about that next.

Wishing you the best of luck
Dr. Maissoun Ziadeh

شرح مفردات المحاضرة الخامسة

Mitosis	الانقسام الخيطي	Separase	المنفصل
Actual process	العملية الفعلية	Cleaves	يشق
Prophase	الطّور التّمهيدي	Cohesins	التماسكات
Prometaphase	الطّورِ الابتدائي	Kinetochores	تركيبة بروتينية معقدة قُرصية (الحيز الحركي)
Metaphase	الطور الاستوائي	Generating	توليد
Anaphase	الطور الانفصالي	Motor Proteins	البروتينات الحركية
Telophase	الطور النهائي	Reel Them	تقوم بلفها
Pertaining	المتعلقة	Elongates	تستطيل
Sitting	الموجودة	Are Far Apart	متباعدتين
Loose	مفكوك	Rebuilt	يعاد بناؤها
Strewn About	متناثرة	Fragments	فتات- شظايا
Tightly Coiled	ملفوف بإحكام	Cytokinesis	التحلل الخلوي
Mitotic Spindle	المغزل الانقسامي	Occur	يحدث
Microtubules	الأنابيب الدقيقة	Distinct	متمايزة
Radial Array	مجموعة شعاعية	Separate	منفصلة
Aster	النجم	Furrow	ثلم
Disassembles	يتفكك	Microfilaments	خيوط دقيقة
Pushes Them Apart	يدفع بعيدًا	Inwards	إلى الداخل
Assembled	تتجمع	Drawstring	الرباط
Tug of War	شد الحبل	Pinches	يضغط
Settled		Fertilized	تخصيب
Poles	أقطاب	Sperm	خلية منوية
Along a Plane	على طول مستوى	Reproductive cells	الخلايا التناسلية
Imaginary Plane	المستوى التخيلي	Gametes	الأمشاج
Metaphase Plate	لوحة الطور	Process	عملية
Stage	المرحلة		
Firmly Attached	مرتبط بإحكام		
To Opposite Ends	بنهايات متقابلة		
Attached	ربط		
Lined Up	تصطف