كلية العلوم

القسم : **علم الحياة**

السنة : **الثالثة**

المادة : بيولوجيا حيوانية

المحاضرة :**8+9** /نظري/ د . ميسون

{{ مكتبة A to Z }}

Facebook Group : مكتبة A to Z

Mitosis- How One Cell Becomes Two

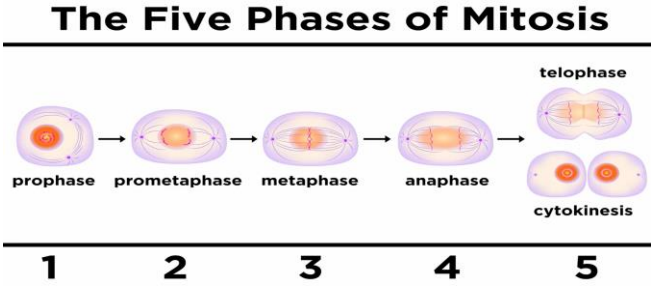
The actual process of cell division, which is called mitosis, is happening all over your body right now, and it's quite complex, so let's take a look at how this works. Mitosis is the process of somatic (body) cell division.

Mitosis is divided into five phases

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

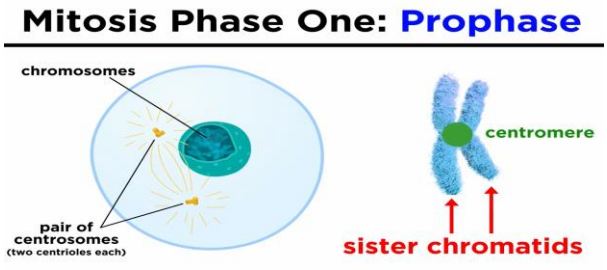
At the completion of telophase, there is also cytokinesis.

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



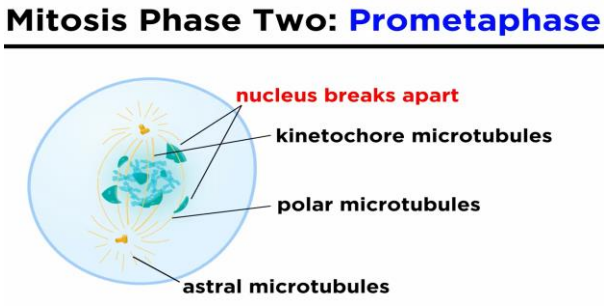
The Prophase

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. Chromatin condenses into visible chromosomes, and the mitotic spindle starts to form.



The Prometaphase

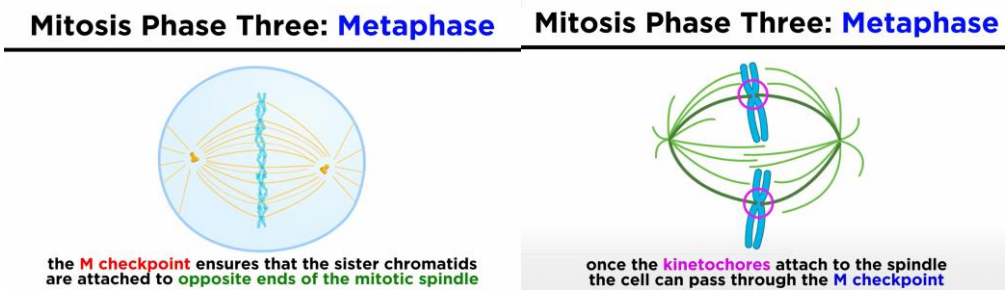
Then, in the prometaphase, the nucleus breaks apart and the growing microtubules cover the area where the nucleus used to be, so that they can attach to special proteins called kinetochores.



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.

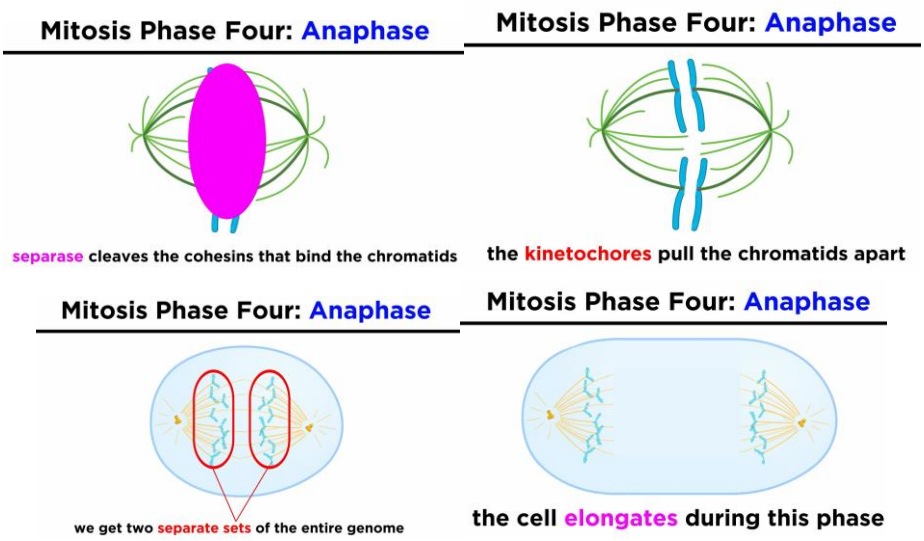


The Anaphase

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.

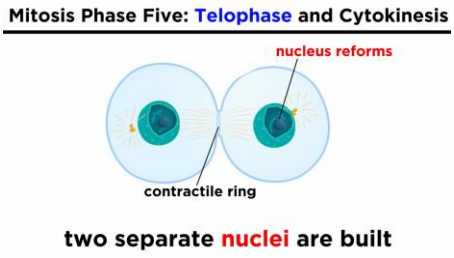
The cell also elongates during this phase, until the two sets of chromosomes are far apart.



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.

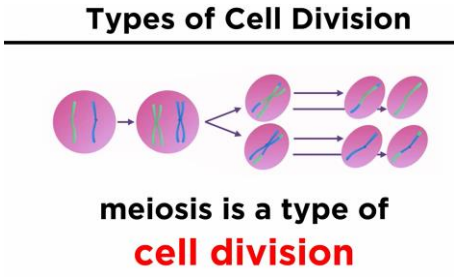


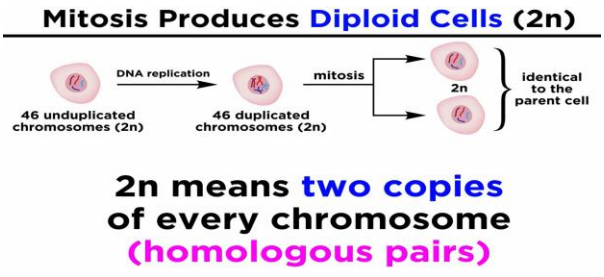
To finish things up, cytokinesis will occur, which is where the cytoplasm, which has already begun dividing the cell into two smaller ones, will continue until the cells are distinct and separate.

A cleavage furrow, formed by actin filaments, pinches the cell in two during cytokinesis, completing mitosis which produces all somatic cells except the original zygot

Meiosis, Gametes, and the Human Life Cycle

Every living creature on earth begins as a single cell.
Meiosis is another type of cell division, but it doesn't produce two identical cells like mitosis does.
While mitosis, a kind of asexual reproduction, just produces identical copies of an original cell, meiosis and subsequent fertilization comprise sexual reproduction, which produces new cells with a novel set of genes.
This is how we get variation from generation to generation.
All humans have a combination of the genetic material from their parents, so no child will be 100% identical to either one of them.



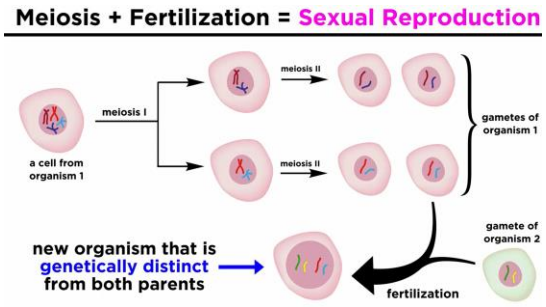


Meiosis

Meiosis consists of two cell divisions rather than one.
These are called meiosis one and meiosis two.

Meiosis one

This consists of prophase one, metaphase one, anaphase one, and telophase one followed by cytokinesis.



In prophase one, each chromosome, already duplicated, exchanges information with the homolog, which is a process called crossing over.

In metaphase one, chromosomes line up at the metaphase plate, and in random fashion.

Then in anaphase one, the homologs separate and are pulled towards the poles by the spindle.

Notice that both chromatids of each chromosome are pulled to one side or the other together, rather than being pulled apart at the centromere, like in mitosis.

Lastly, **in telophase one**, the nuclear membrane reforms, cytokinesis occurs, and we get two haploid daughter cells.

Meiosis two

Then in meiosis two, again we have prophase two, metaphase two, anaphase two, telophase two and cytokinesis.

This part looks just like mitosis.

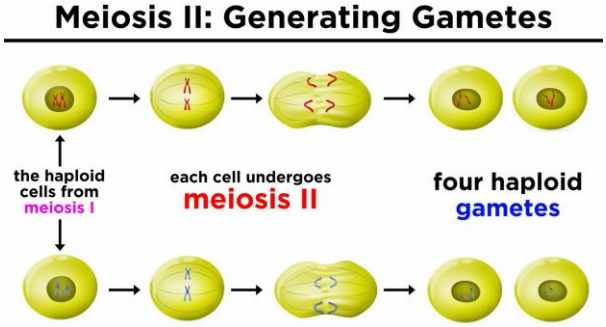
In prophase two, the spindle apparatus forms.

In metaphase two, the chromosomes align at the metaphase plate, but unlike mitosis, the sister chromatids are not all genetically identical, because of the crossing over that occurred in prophase one.

Again, the spindle attaches to kinetochores so that **in anaphase two**, the sister chromatids are pulled apart towards the poles.

Then telophase two and **cytokinesis** occur, where nuclei form, and we are left with four haploid cells, each with 23 unduplicated chromosomes.

Each of these four daughter cells is different from the parent cell, and they are all different from each other.



In fact, due to all the different possibilities present for the assortment and distribution of the chromosomes, each haploid daughter cell, or gamete, represents one unique outcome out of millions of possible outcomes.

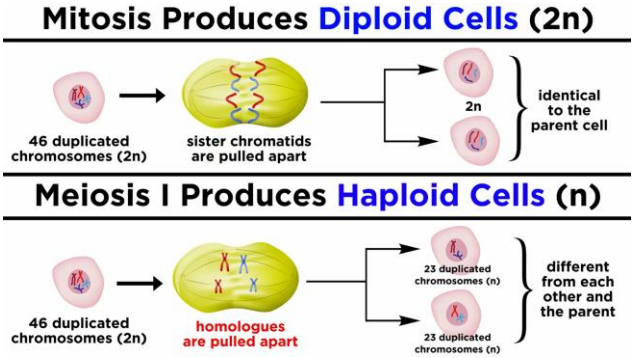
This is the secret to biological variation that sexual reproduction offers, which gives rise to the wide variety of phenotypes in living organisms.

So the human life cycle begins with haploid cells, in this case a sperm and an egg. These specialized cells are products of meiosis, and contain just one set of 23 chromosomes each.

When these fuse during fertilization, the product is a single diploid cell with both sets of chromosomes, one from each of the parents.

From here, it is mitosis that leads to the development of a human being, which will then exhibit characteristics from both parents.

But what factors determine which characteristics from the mother and father will show up in a child and which will not?



Compare mitosis and meiosis

Feature	Mitosis	Meiosis
Type of Reproduction	Asexual (somatic/growth)	Sexual (production of gametes)
Purpose / Function	Growth, tissue repair, asexual reproduction.	Production of haploid gametes (sperm and egg) for sexual reproduction.
Number of Divisions	One division (PMAT + cytokinesis)	Two consecutive divisions (Meiosis I and Meiosis II)
Number of Daughter Cells	Two diploid (2n) cells	Four haploid (n) cells
Chromosome Number	Identical to parent cell (diploid → diploid, 2n → 2n)	Halved (diploid → haploid, 2n → n)
Genetic Identity	Genetically identical to parent cell and to each other.	Genetically non-identical to parent cell and to each other.
Occurs In	Somatic cells (body cells)	Germ cells (in ovaries and testes)
Role in Life Cycle	Enables organism growth and maintenance from a zygote.	Produces gametes to form a zygote.

Wishing you the best of luck
Dr. Maissoun Ziadeh

Mitosis	الانقسام الخيطي	Duplicated	تتضاعف
Actual process	العملية الفعلية	Characteristics	الخصائص
Prophase	الطّور التّمهيدي	Somatic Cells	الخلايا الجسدية
Prometaphase	الطّورِ الابتدائي	Diploid Cells	الخلايا ثنائية الصّيغة الصبغية
Metaphase	الطور الاستوائي	Haploid	أحادية الصّيغة الصبغية
Anaphase	الطور الانفصالي	Gametes	الأمشاج
Telophase	الطور النهائي	Sperm Cells	الحيوانات المنوية
Cytokinesis	انقسام السيتوبلازم	Egg Cells	البويضات
Pertaining to	المتعلّقة بـ	Merge	يندمج
Tightly Coiled	ملفوف بإحكام	Maternal	للأم
Mitotic Spindle	المغزل الانقسامي	Paternal	للأب
Microtubules	الأنابيب الدقيقة	Comprise	يشتمل
Aster	النجم	Novel set	مجموعة جديدة
Assembled	تتجمع	Variation	الاختلاف
Along a Plane	على طول مستوى	Generation	جيل
Imaginary Plane	المستوى التخيلي	Instance	مثيل
Metaphase Plate	لوحة الطور	Recombinant	المؤتلفة
Stage	المرحلة	Mitotic Spindle	المغزل الانقسامي
Cleaves	يشق	Metaphase Plate	لوحة الطور
Cohesins	التماسكات	Line Up	تصطف
Lined Up	تصطف	Poles	القطبين
Separate	منفصلة	Reforms	الإصلاحات
Furrow	ثلم	Exchanged	تبادل
Meiosis	الانقسام الاختزالي	Possibilities	الاحتمالات
Asexual	اللاجنسي	Unique Outcome	نتيجة فريدة
Homologous	متماثل	Fuse	تندمج
Crossing over	العبور	Development	تطور