Biology 3201

Unit 1: Part 1

Name: ______________________________

Mr. Gillam Holy Heart

Activity Launch Lab – Cell Division

Genetic Material in the Nucleus

___________________________ a length of DNA and associated protein; condensed form of genetic material

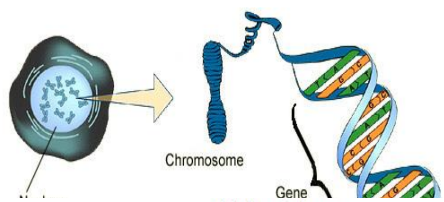
Two Types:

1. __________________________ X or Y chromosome; determines genetic sex

2.) _________________________ chromosome other than sex chromosome

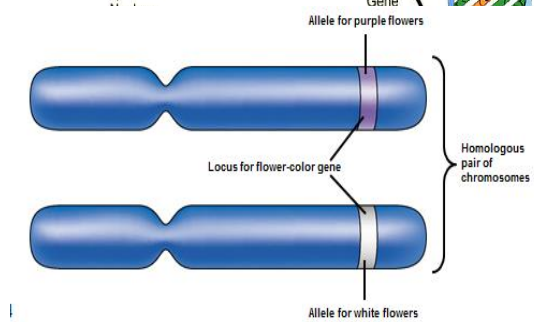
____________________________non-condensed form of genetic material that predominates for most of the life cycle of the cell

The genetic information of a cell is contained in its ____ a molecule of nucleic acid that governs processes of heredity in the cells of organisms.



________________ governs expression of a trait

_________________one of the different forms of the same gene



Somatic Cells

______________________ life cycle of a cell

______________________ body cell

Human somatic cells have 46 chromosomes and are diploid.

22 pairs of autosomes

1 pair of sex chromosomes

____________________ cell with two pairs of homologous chromosomes (2n)

____ chromosomes with the same gene sequence

The autosomes are numbered 1 through 22. The sex chromosomes are called X and Y.

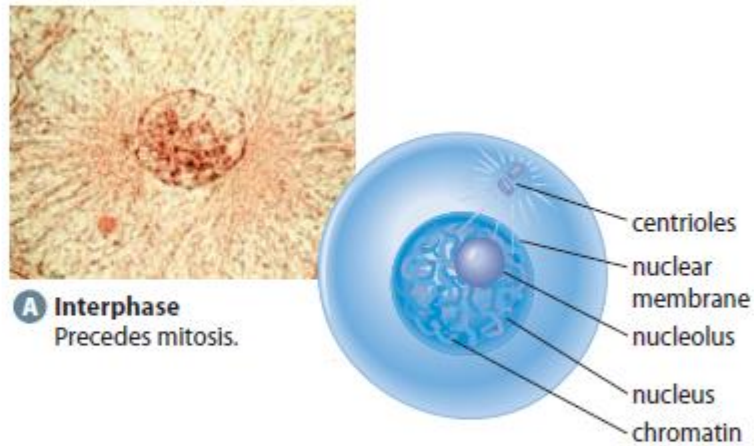
The lives of somatic cells vary, based on their type and their environment.

For example, ____________________________, are replaced frequently, so the cells that produce them divide _____________________________.

________________________________, divide ____________________________ or not at all.

For the many somatic cells that divide, the cell cycle consists of a _________________________________ during which a cell seems to be resting and a period during which it ____________________.

The Cell Cycle



______________________ growth stage of cell cycle

There are three phases in interphase: G1, S, and G2.

_______________________: The cell grows quickly during this phase, making many new cell molecules (except DNA).

- Protein Synthesis

- Organelles are produced

- Increase volume of the cytoplasm

_______________________: The DNA in the chromatin replicates to create an identical copy of DNA.

Cell duplicates its DNA

These two identical chromosomes, called sister chromatids.

_________________________________ one of two chromosomes that are genetically identical and held together at the centromere

The __________________________ is the specialized DNA sequence of a chromosome that links a pair of sister chromatids

_______________________: This second growth stage lets the cell rebuild its reserves of energy to prepare for division. As well, the cell manufactures proteins and other molecules to make structures required for division of the nucleus and cell.

- Organelles are produced
- Increase volume of the cytoplasm
- Interphase ends when the cell begins the process of nuclear division.

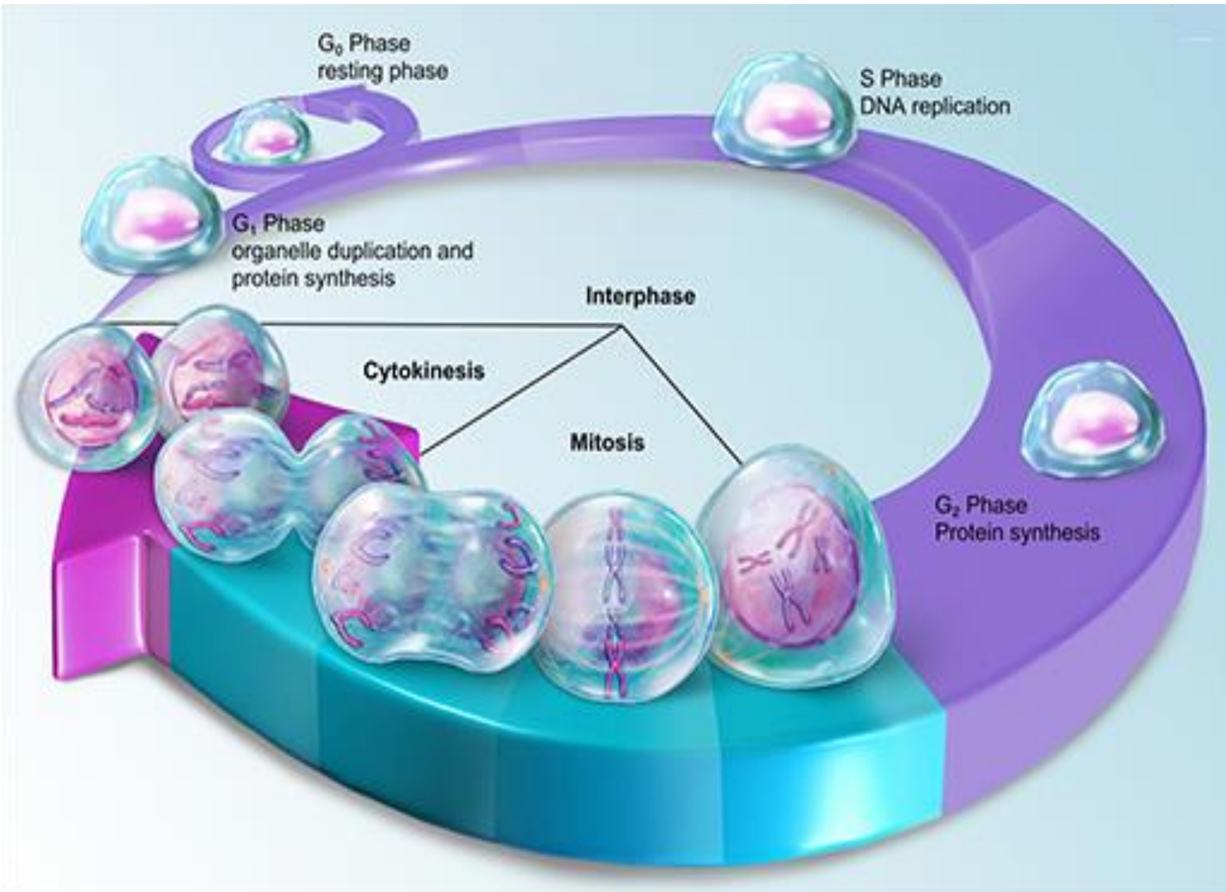
Cell Division

There are **two** main processes in cell division:

__________________division of genetic material and the cell's nucleus.

Prophase
Metaphase
Anaphase
Telophase

_________________ separation of the cytoplasm and organelles to form two separate daughter cells



The linked processes of mitosis and cytokinesis have three important functions:

_____________________: They enable organisms to grow from a single-celled zygote into a mature organism that may contain hundreds of trillions of cells.

_____________________: They produce new cells to replace worn out or dead cells.

_____________________: They can regenerate damaged tissues. If you cut your finger, skin cells reproduce so that new skin can grow over the injured area.

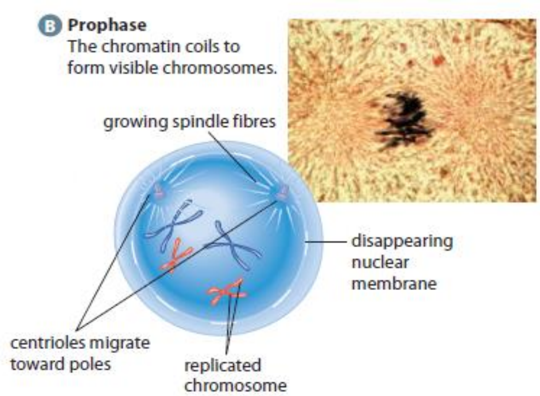
Mitotic Phases - Prophase

1. The chromatin condenses into tightly packed chromosomes.

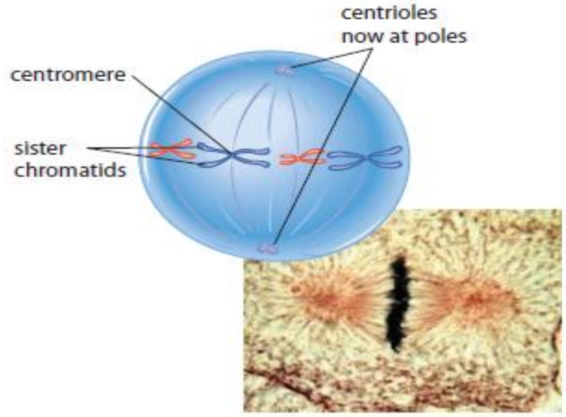
2. The nuclear membrane breaks down, releasing the chromosomes into the cytoplasm.

3. The nucleolus disappears.

4. One pair of cylindrical organelles, called centrioles, moves apart to opposite poles of the cell.



______________________: a cylindrical organelle near the nucleus in animal cells, occurring in pairs and involved in the development of spindle fibers in cell division.



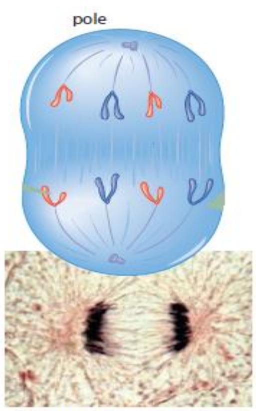
C Metaphase The chromosomes move to the equator of the cell.

Mitotic Phases - Metaphase

1. The spindle fibres guide the chromosomes to the equator, or centre line, of the cell.

2. The spindle fibres from opposite poles attach to the centromere of each chromosome.

Each pair of sister chromatids is considered to be a single chromosome as long as the chromatids remain joined at the centromere.



D Anaphase The centromeres split and the sister chromatids are pulled apart to opposite poles of the cell.

Mitotic Phases - Anaphase

1. Each centromere splits apart and the sister chromatids separate from one another.

2. The spindle fibres that link the centromeres to the poles of the cell shorten.

3. As these fibres shorten, sister chromatids are pulled to opposite poles. At the same time, other microtubules in the spindle apparatus lengthen and force the poles of the cell away from one another.

At the end of anaphase, one complete diploid set of chromosomes has been gathered at each pole of the elongated cell.

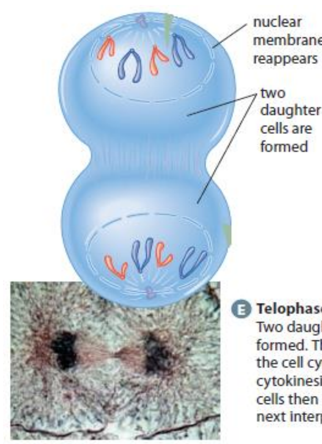
Mitotic Phases - Telophase

1. Telophase begins when the chromatids have reached the opposite poles of the cell.

2. The chromatids begin to unwind into the longer and less visible strands of chromatin.

3. The spindle fibres break down.

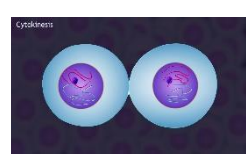
4. A nuclear membrane forms around each new set of chromosomes, and a nucleolus forms within each new nucleus.



E Telophase Two daughter cells are formed. The cells divide as the cell cycle proceeds into cytokinesis. Both daughter cells then proceed into the next interphase.

Cytokinesis - Animals

In animal cells, a cleavage furrow forms in the cell membrane along the cell equator. This indentation deepens until the cell is pinched in two.



______________________ an indentation that appears in a cell's surface when the cell is preparing to divide.

The cytoplasm and organelles divide equally between the two halves of the cell.

Cytokinesis ends with the separation of the two genetically identical daughter cells.

Cytokinesis - Plants

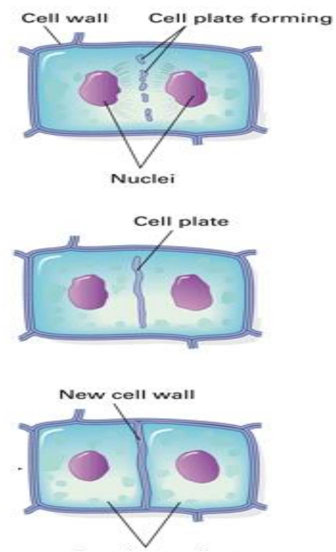
Plant cells do not have centrioles, but they do form a spindle apparatus.

The rigid cell wall of a plant cell is much stronger than the membrane of an animal cell.

The cell wall does not furrow and pinch in during cytokinesis.

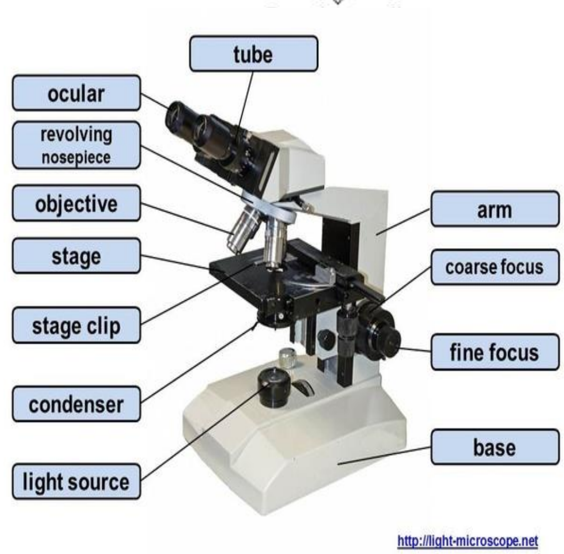
Instead, a membrane called a cell plate forms between the two daughter nuclei.

This cell plate extends across the diameter of the cell, and it is then reinforced by the addition of cellulose and proteins to create a new cell wall.



Using the Microscope

1. Make sure that the low-power objective lens is in position. If not, rotate the nosepiece until the low-power objective lens clicks into place.
2. Look through the eyepiece and adjust the diaphragm until the view is as bright as possible.
3. Place a prepared slide on the stage and secure it in place with the stage clips. Make sure the object you want to view is centred over the opening in the stage.
4. Look through the eyepiece. Slowly turn the coarse adjustment knob until the object is in focus. Use the fine adjustment knob to sharpen the focus.
5. Once the object is in focus using low power, carefully rotate the nosepiece to the medium-power objective lens making sure it does not strike the surface of the slide



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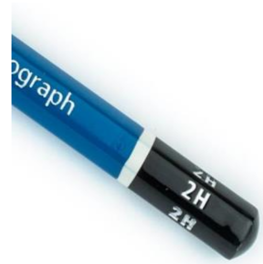
6. Once you have located it under medium power you may want to try and locate the specimen under high power.
7. Rotate the nosepiece to the high power objective making sure it does not hit the slide and use the fine adjustment knob to focus.

Biological Drawings



A clear, concise drawing can often replace words in a scientific description. Drawings are especially important when you are trying to explain difficult concepts or describe complex structures.

Follow these steps to make a good scientific drawing:
1. Use an unlined (blank) sheet of paper and a sharp lead pencil, ideally _____, for the drawing, title, and all labels.
2. Make sure your drawing will be large enough to show all the necessary details; a drawing about half a page in size is usually sufficient. Also allow space for the labels, which identify parts of the object you are drawing.
3. Make your drawing as simple as is possible
4. include the boundaries of the other cells surrounding.
5. Shading is not usually used in scientific drawings. To indicate darker areas in your drawing, use stippling (a series of dots)
6. Label your drawing carefully and completely. All labels should be horizontal, printed in lower-case, and placed in a column to the right of your drawing.
7. Use a ruler to draw a horizontal line from each label to the structure you are identifying. Make sure that none of these label lines cross each other.
8. Give your drawing a title. The title should appear immediately above the drawing. The title should be printed and underlined. Indicate the magnification of the drawing in parentheses.

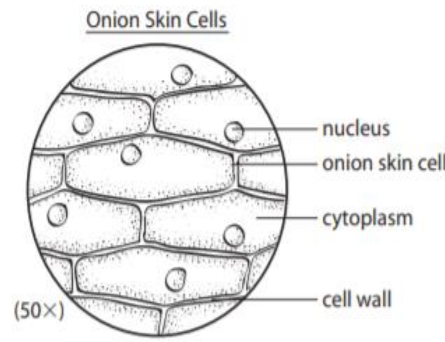


Figure D.2 The stippling on this drawing of onion skin cells, as observed under a microscope, shows that some areas are darker in appearance than others.

Modeling Mitosis - Investigation 12.A

Use the template provided to model a cell with a diploid number of 8. Include prophase, metaphase, anaphase and telophase.

Mitosis Lab - Investigation 12.C

Cancer and The Cell Cycle

___________________ uncontrolled cell division.

Quality control checkpoints are built into the cell cycle to ensure that each cell meets a certain standard.

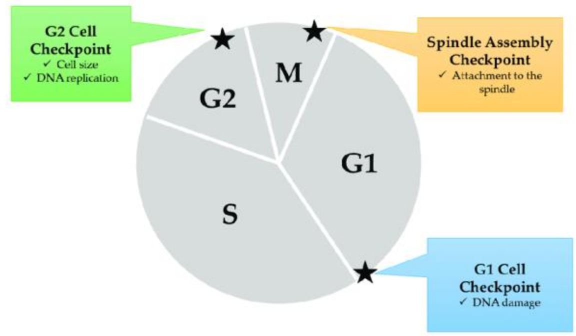
In the cell cycle, the role of inspector at each checkpoint is played by various regulatory proteins.

As a cell approaches the end of the G1 phase, a period of rapid growth and metabolic activity, it passes through a checkpoint known as G1/S. The cell checks for DNA damage to ensure that DNA synthesis in S phase will be successful.

Cells with undamaged DNA successfully pass through this checkpoint and proceed to S phase.

Cells with damaged DNA either undergo repair or, if repair isn't possible, programmed cell death, called apoptosis.

Cells pass through a similar checkpoint in the G2 phase, after DNA synthesis in S phase, prior to cell division.



Cancer and The Cell Cycle

When this checkpoint system is working properly, it maintains healthy cell reproduction throughout an organism's lifetime. However, sometimes the genes that code for the regulatory proteins become altered, producing a malfunctioning protein or no protein at all.

As a consequence, uncontrolled cell division may occur, resulting in the development of cancer.

Uncontrolled cell growth in cancer can result in the formation of a tumour, may alter the function of normal body tissues, and is able to invade other parts of the body. Typically, more than one change to DNA is needed to cause cancer.

Cancer Therapies

Surgery

_________________________________ removes the tumor and nearby tissue during an operation.

The types and severity of side effects vary from person to person based on several factors:

- Location and type of cancer
- Type of surgery
- Pain, fatigue, appetite loss, other organs, swelling, drainage, infection, bruising, numbness, and bleeding.

Radiation Therapy

_________________________________ is a cancer treatment that uses high doses of radiation to kill cancer cells and shrink tumors.

At high doses, radiation therapy kills cancer cells or slows their growth by damaging their DNA. Cancer cells whose DNA is damaged beyond repair stop dividing or die. When the damaged cells die, they are broken down and removed by the body.

Most commonly used to treat cancers of the head and neck, breast, cervix, prostate, and eye

Side Effects of Radiation Therapy

Fatigue Hair loss Nausea and vomiting Skin changes Headache
Blurry vision Swelling (Edema) Tenderness Cough Shortness of breath
Sexual problems (men) Fertility problems (men) Sexual problems (women)
Fertility problems (women) Urinary and bladder changes Diarrhea

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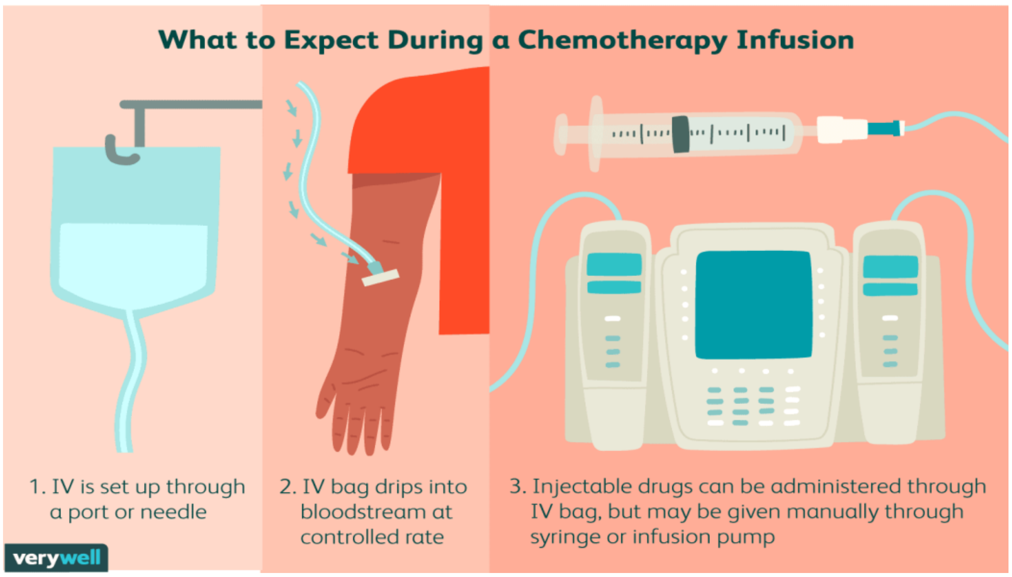
Chemotherapy

__________________________ is a drug treatment that uses powerful chemicals to kill fast-growing cells in your body.

Chemotherapy is most often used to treat cancer, since cancer cells grow and multiply much more quickly than most cells in the body.



When is Chemotherapy used?

To _____________ the cancer without other treatments. Chemotherapy can be used as the primary or sole treatment for cancer.

____, to kill hidden cancer cells. Chemotherapy can be used after other treatments, such as surgery, to kill any cancer cells that might remain in the body. Doctors call this adjuvant therapy.

____. Chemotherapy can be used to shrink a tumor so that other treatments, such as radiation and surgery, are possible.

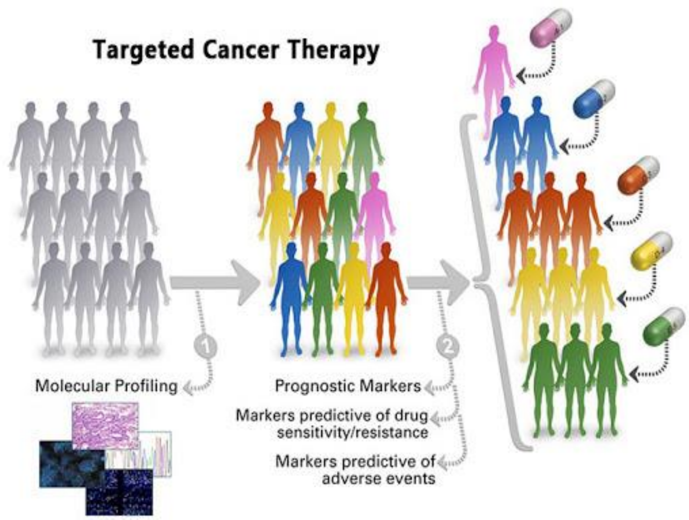
____. Chemotherapy may help relieve signs and symptoms of cancer by killing some of the cancer cells. Doctors call this palliative chemotherapy.

Side Effects of Chemotherapy

Nausea	Vomiting	Diarrhea	Hair loss	Loss of appetite
Fatigue	Fever	Mouth sores	Pain	Constipation
Easy bruising	Bleeding			

Targeted Therapy

________________________________ is a cancer treatment that uses drugs to target specific genes and proteins that are involved in the growth and survival of cancer cells.



Targeted therapy can affect the tissue environment that helps a cancer grow and survive or it can target cells related to cancer growth, like blood vessel cells.

Breast Cancer, Leukemia, Colorectal Cancer, Lung Cancer, Lymphoma, Melanoma

Immunotherapy - Research Project

What can Targeted Therapy do?

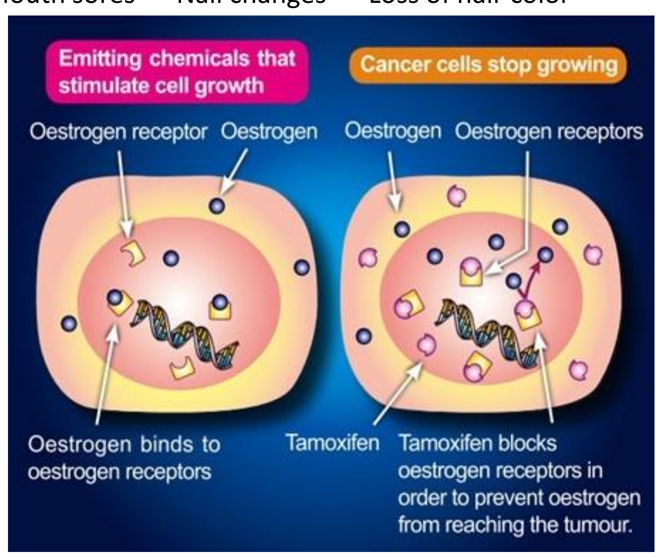
- Block or turn off signals that tell cancer cells to grow and divide
- Prevent the cells from living longer than normal
- Destroy cancer cells

Side Effects of Targeted Therapy

Diarrhea Liver problems Blood clotting Slow wound healing
High blood pressure Fatigue Mouth sores Nail changes Loss of hair color
rash and dry skin

Hormone Therapy

_____________________________________ is a cancer treatment that slows or stops the growth of cancer that uses hormones to grow. Hormone therapy is also called hormonal therapy, hormone treatment, or endocrine therapy.



Hormone therapy is used to:

_______________________________. Hormone therapy can lessen the chance that cancer will return or stop or slow its growth.

____. Hormone therapy may be used to reduce or prevent symptoms in men with prostate cancer who are not able to have surgery or radiation therapy.

When is it used?

- Hormone therapy is used to treat prostate and breast cancers that use hormones to grow.
- Hormone therapy is most often used along with other cancer treatments.

Side Effects of Hormone Therapy

Some common side effects for men who receive hormone therapy for prostate cancer include:

hot flashes loss of interest in or ability to have sex weakened bones
diarrhea Nausea enlarged and tender breasts fatigue

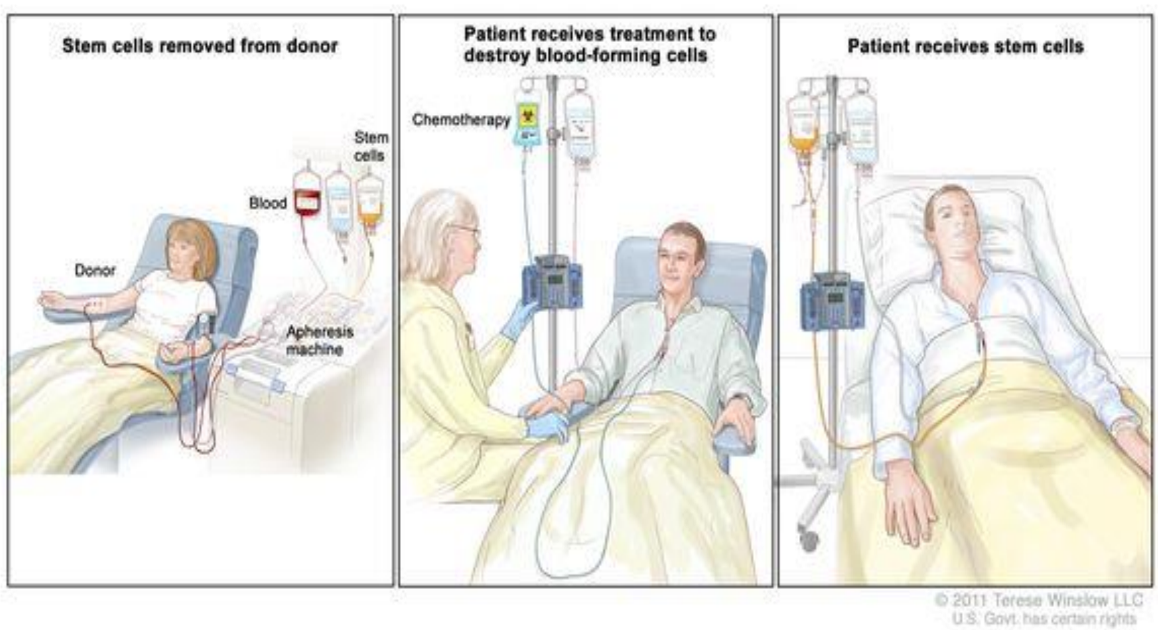
Some common side effects for women who receive hormone therapy for breast cancer include:

hot flashes vaginal dryness changes in your periods if you have not yet reached menopause loss of interest in sex nausea mood changes fatigue

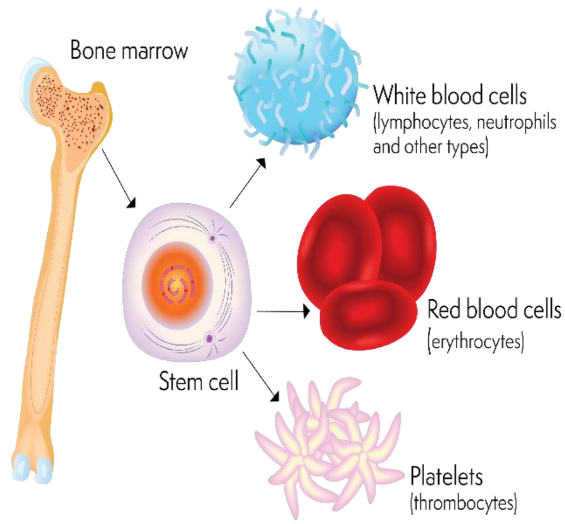
Stem Cell Transplants

In a ____, healthy stem cells are placed in your body to help your bone marrow start to work properly. The new stem cells make healthy blood cells.

- It is used when stem cells or bone marrow have been damaged or destroyed by cancer or disease.
- Used to treat some cancers such as leukemia, lymphoma, multiple myeloma and neuroblastoma.
- It may also be used after high-dose radiation and chemotherapy to treat the cancer.



How it works



The stem cells in the bone marrow turn into red blood cells, white blood cells and platelets.

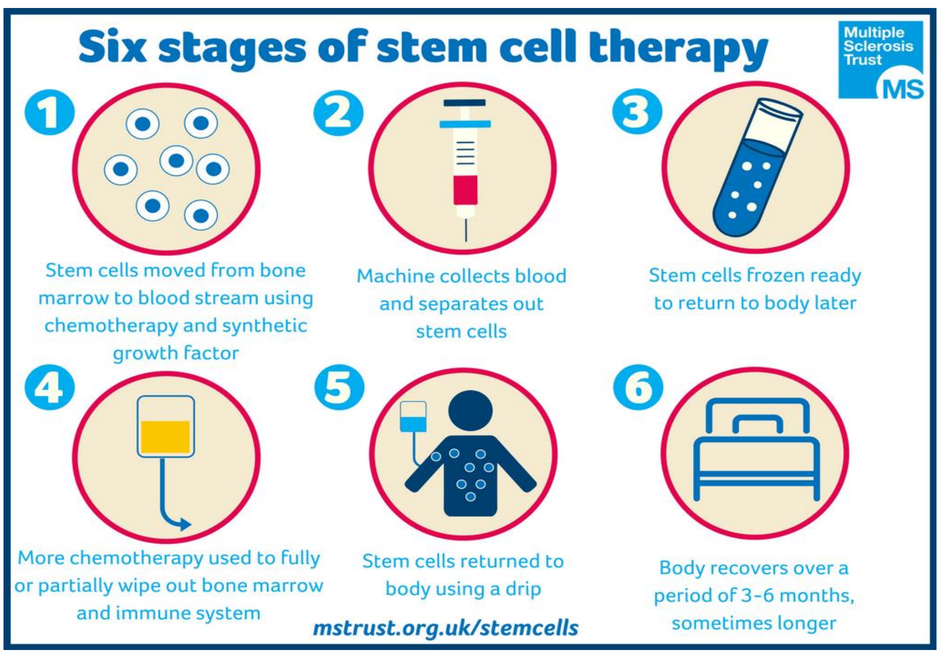
When these blood cells mature they move into the peripheral blood (the blood that flows through the body).

If the bone marrow is damaged or destroyed, it can't make normal blood cells.

In a stem cell transplant, healthy stem cells are placed in your body to help your bone marrow start to work properly. The new stem cells make healthy blood cells.

A stem cell transplant is very complex.

It can take 6 to 12 months or longer for your blood counts to be back to normal and your immune system to work well.



Side effects of a stem cell transplant can be very serious or even life-threatening.

Side Effects of Stem Cell Transplant

All of the side effects associated with chemotherapy and radiation they are common as well as:

Low blood cell counts Infection Bleeding Anemia Veno-occlusive disease

Digestive system problems - sore mouth and throat, nausea and vomiting, loss of appetite, weight loss, Diarrhea

The Formation of Reproductive Cells

A cell that contains unpaired chromosomes is said to be haploid

________________cell with half the number of chromosomes

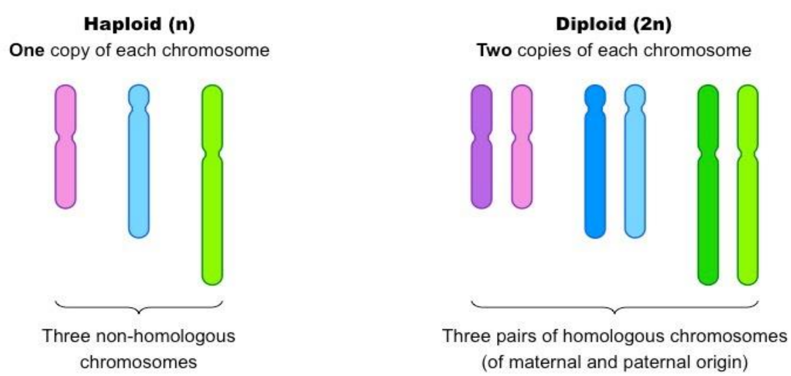
________________cell division that produces haploid gametes from a germ cell

__________________________ gamete producing cell

__________________ are an organism's reproductive cells. They are also referred to as _____________

Female gametes are called ova or egg cells, and male gametes are called sperm.

Gametes are haploid cells, and each cell carries only one copy of each chromosome.



During sexual reproduction, however, a haploid gamete from the male organism and a haploid gamete from the female organism fuse to create a new cell.

The resulting diploid zygote has genetic information from both parents and the same number of chromosomes as its parents.

For this to be possible, the gametes of an organism must contain half the number of chromosomes as the somatic cells of the organism.

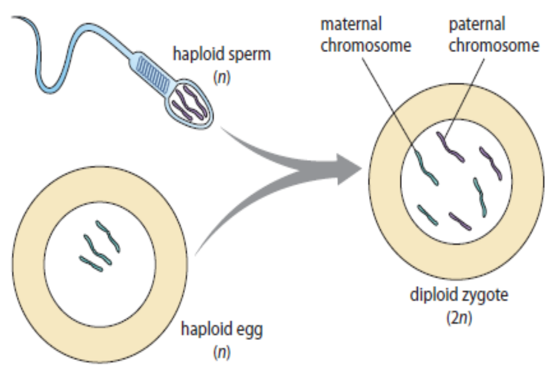


Figure 12.8 The union of two haploid gametes forms a diploid zygote. The zygote contains chromosomes from each parent. The chromosomes that are donated from the ovum are of *maternal origin* and those from the sperm cell are of *paternal origin*.

Meiosis

____: Meiosis is sometimes referred to as a reduction division because it is a form of cell division that produces cells with fewer chromosomes than the parent cells.

___________________________________: The products of meiosis have different combinations of genes. Genetic recombination gives rise to offspring that are genetically distinct from one another and their parents.

Meiosis, involves two complete rounds of phases, called _______________ and ___________________.

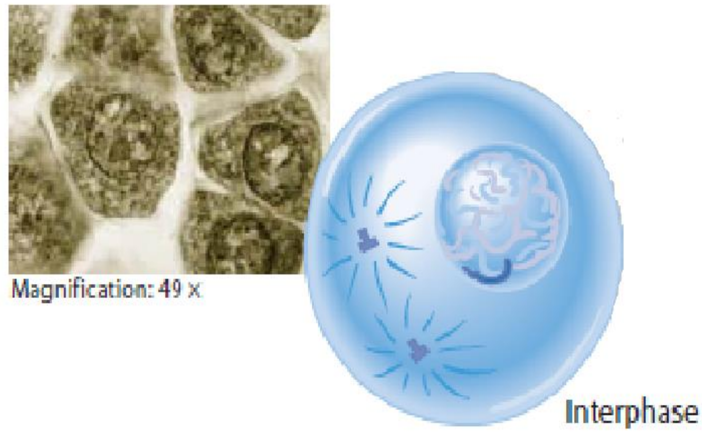
Interphase

Germ cells proceed through the growth and synthesis phases of interphase before dividing.

Chromosomes are replicated during the S phase of interphase.

This also occurs before a germ cell begins meiosis. At the start of meiosis, therefore, a germ cell contains duplicated chromosomes.

Each chromosome is made up of a pair of identical sister chromatids held together at the centromere.



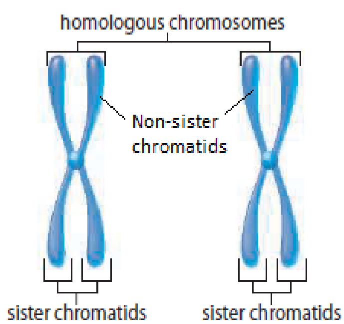


Figure 12.10 A chromosome tetrad is made up of two pairs of non-sister chromatids arranged side by side. Homologous chromosomes carry the same genes at the same locations, but may carry different alleles of these genes. Sister chromatids, in contrast, are identical to each other.

Meiosis 1– Prophase 1

In prophase I, each pair of homologous chromosomes align side by side.

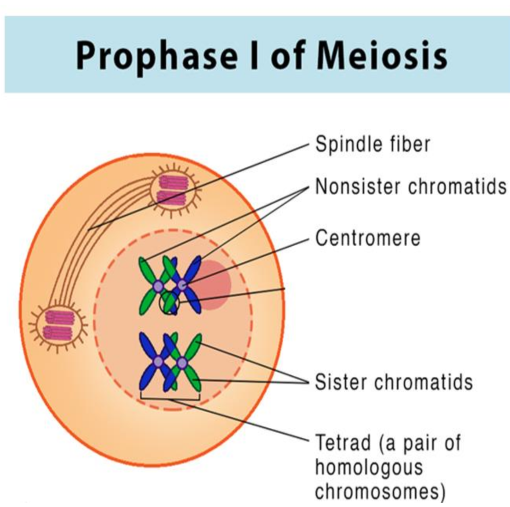
____________________aligning of homologous chromosomes in prophase I

Because each consists of two chromatids, a pair of homologous chromosomes is made up of four chromatids and is called a tetrad.

____

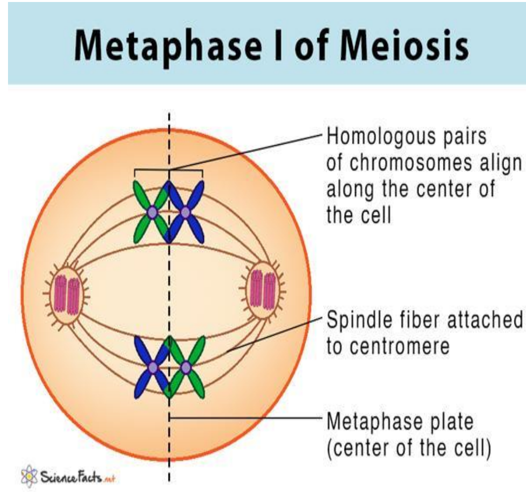
chromatids in a tetrad that do not belong to the same chromosome

______________________________is one of two strands of a copied chromosome.



__________________________ homologous chromosome pair; contains four chromatids

Meiosis 1 – Metaphase 1

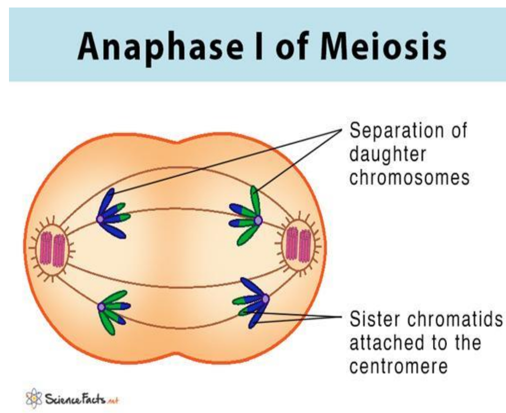


A spindle fibre attaches to the centromere of each chromosome. A spindle fibre from one pole attaches to one pair of sister chromatids in the tetrad, and a spindle fibre from the opposite pole attaches to the other pair of sister chromatids. The spindle fibres guide each tetrad to the equator of the cell. The chromosomes, however, do not line up in single file as they do in mitosis.

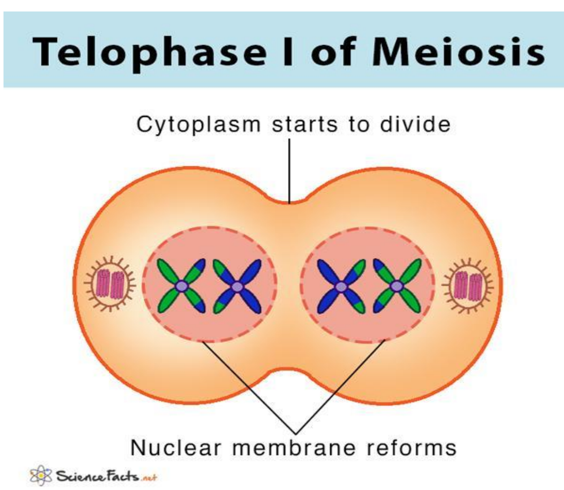
Instead, they line up as homologous pairs.

In each pair, one homologous chromosome is positioned on one side of the cell's equator, and the other homologous chromosome is positioned on the other side of the cell's equator.

Meiosis 1 – Anaphase 1



During anaphase I, the spindle fibres shorten. This causes the homologous chromosomes to separate from one another. The homologues move to opposite poles of the cell. Because the sister chromatids are still held together, the centromeres do not split as they do in mitosis. The result is that a single chromosome (made up of two sister chromatids) from each homologous pair moves to each pole of the cell.



Meiosis 1 – Telophase 1

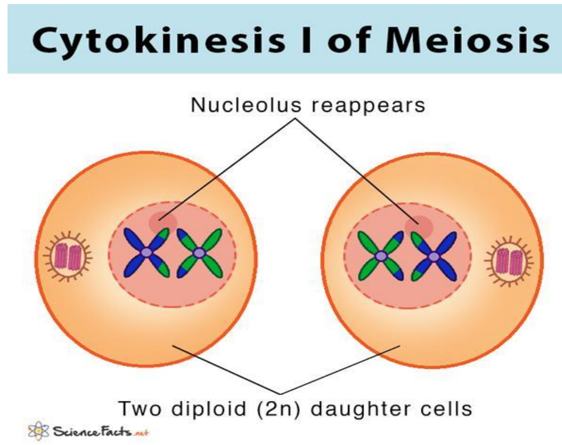
Some cells move directly from anaphase I to meiosis II

Other cells go through telophase I following anaphase I. In telophase I, the homologous chromosomes begin to uncoil and the spindle fibres disappear. The cytoplasm is divided, the nuclear membrane forms around each group of homologous chromosomes, and two cells are formed. Each of these new cells contains one set of sister chromatids and is now haploid.

Chromosome replication does not take place before the next phase of meiosis.

Meiosis 1 – Cytokinesis 1

It involves the division of the cytoplasm to produce two individual daughter cells.

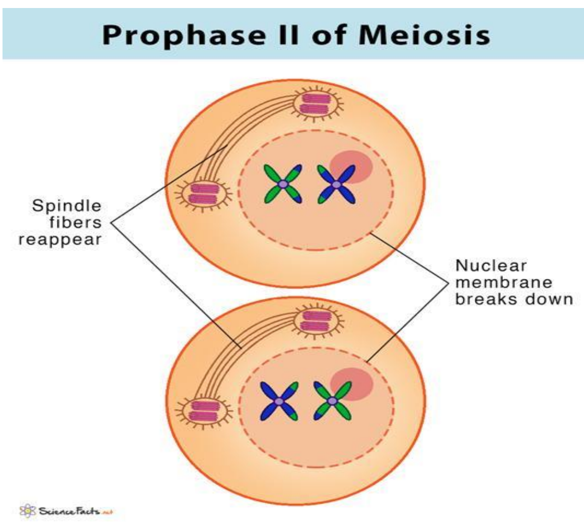


____

At the end of cytokinesis I, two different daughter cells are formed, each with half the number of chromosomes as the parent cell (having 23 chromosomes having 23 pairs of chromatids).

These chromosomes are often called double stranded

Each cell that enters meiosis II is haploid but consists of replicated chromosomes.



Meiosis II – Prophase II

The nuclear membrane initiates to break down, and the spindle fibers appear again.

Each centriole divides, forming two pairs of centrioles.

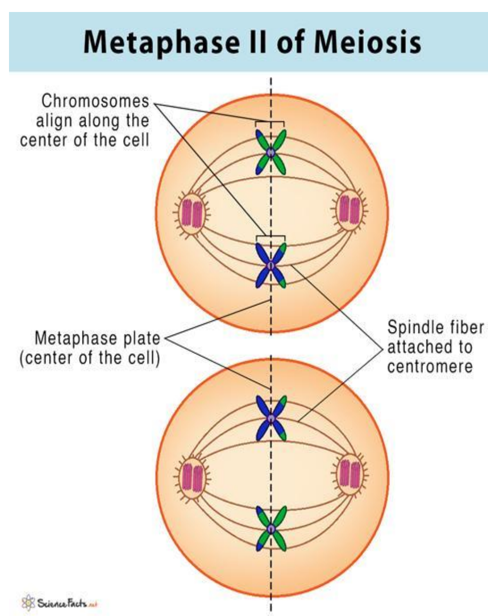
Chromosomes do not replicate any further in this phase of meiosis and begin migration towards the center of the cell.

Meiosis II – Metaphase II

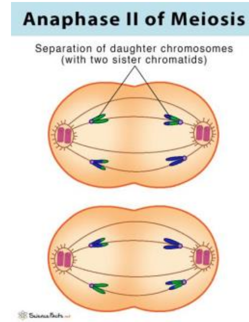
Chromosomes arrange on the equator of the cell with the help of the spindle fibers.

The centrioles are now at opposite poles in each of the daughter cells.

Centromere divides, producing two sister chromatids, now known as daughter chromosomes, with the spindle fibers attached to each chromosome.



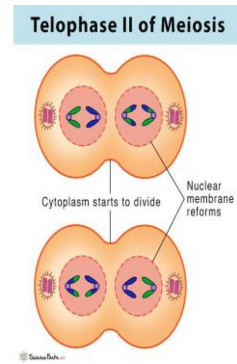
Meiosis II – Anaphase II



The daughter chromosomes are pulled towards the opposite poles of the cells with the help of the spindle fibers.

At the end of anaphase II, each end of the cell contains a complete set of chromosomes.

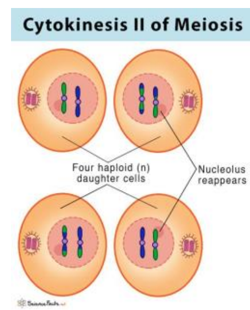
Meiosis II – Telophase II



The nuclear membrane forms around each chromosome with the disappearance of the spindle fibers.

Nucleolus reappears as the cell prepares for the second round of cytoplasmic division.

Cytokinesis II



This step is identical to cytokinesis I, involving the second cytoplasm division, resulting in the formation of two individual daughter cells.

____

At the end of meiosis II, four non-identical, haploid daughter cells are formed, each having half chromosome number as the original parent cell.

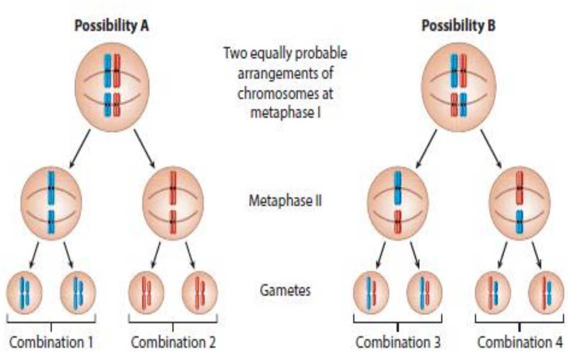
Meiosis and Genetic Variation

During meiosis, genetic variation is ensured in two ways:

1. By the creation of gametes that carry different combinations of maternal and paternal chromosomes - ____

2. By the exchange of genetic material between maternal and paternal chromosomes – ____

Figure 12.11 There are two different ways that the two pairs of homologous chromosomes could align at metaphase I. This results in four different gametes.



Independent Assortment

The independent assortment of homologous chromosomes during metaphase I results in gametes that have different combinations of parental chromosomes.

Crossing Over

_____________________________ exchange of genetic material between non-sister chromatids

While they are lined up side by side in prophase I, non-sister chromatids may exchange pieces of chromosome

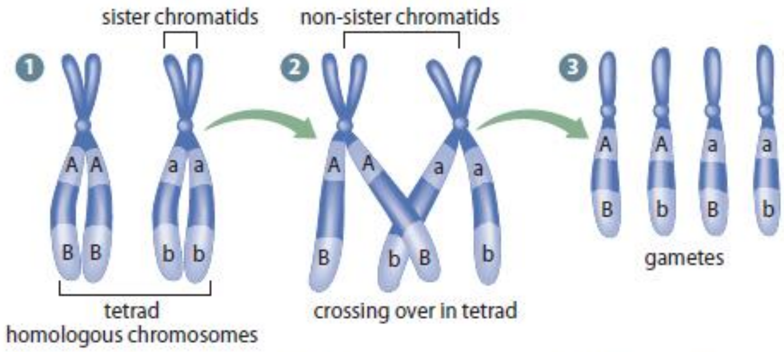
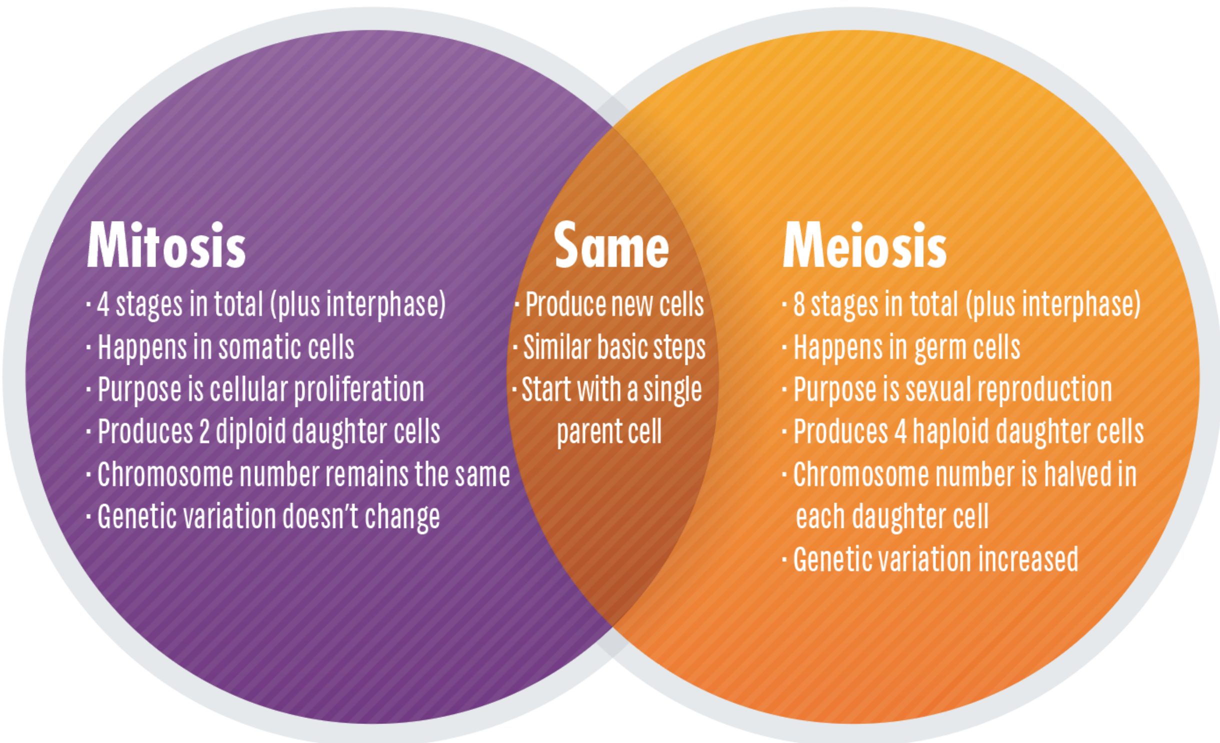


Figure 12.12 Crossing over occurs at random between pairs of homologous chromosomes. In these chromosomes, upper-case and lower-case letters denote different alleles, or different versions of the same gene. **(1)** During prophase, homologous chromosomes form pairs. **(2)** Non-sister chromatids cross over each other and exchange segments of chromosomes. As a result, chromosomes in the gametes **(3)** contain new combinations of genetic material.

Figure 12.13 Crossing over between non-sister chromatids can occur at several points simultaneously.

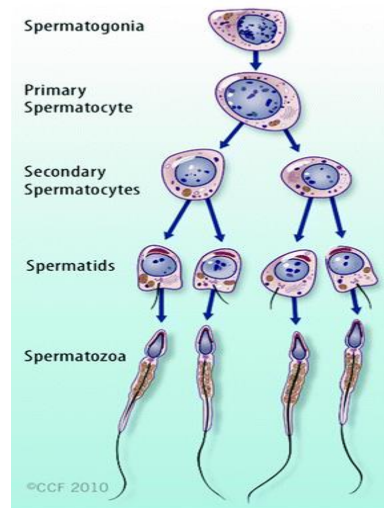
Mitosis vs Meiosis



Activity Modelling Meiosis - Investigation 12.B

Mr. Gillam Holy Heart

Spermatogenesis



_____________________________ process of male gamete production

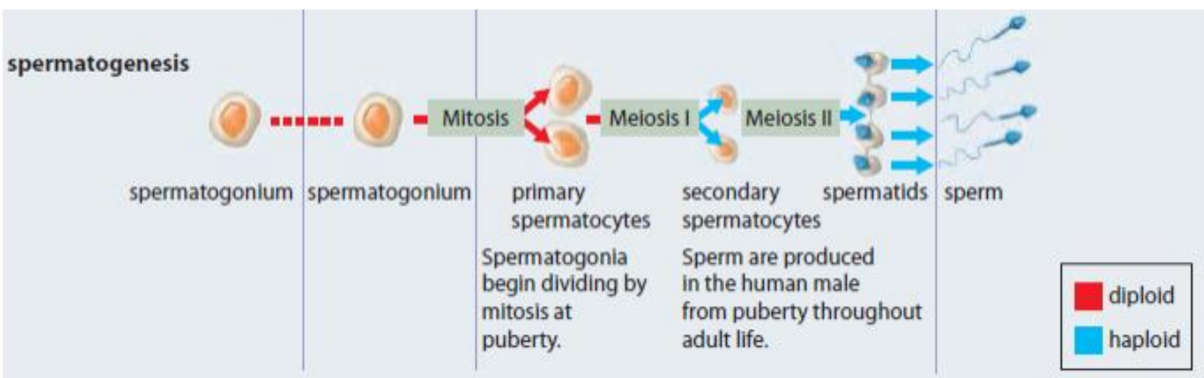
____ diploid germ cell from which sperm are produced

Beginning at puberty, spermatogonia are stimulated to divide by mitosis to form two daughter cells. One of these cells replenishes the spermatogonia cell population, and the other develops into a primary spermatocyte.

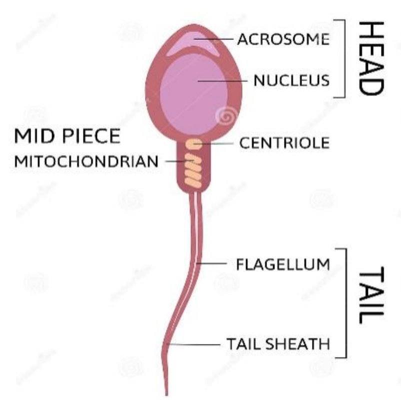
The primary spermatocyte undergoes meiosis I to form two secondary spermatocytes. The secondary spermatocytes then undergo meiosis II to form four spermatids.

Following meiosis II, the spermatids go through a final set of developmental stages in order to develop into mature sperm cell.

___________________________ male gamete



Sperm Cell



A mature sperm is a tadpole-shaped structure, about 0.05 mm long.

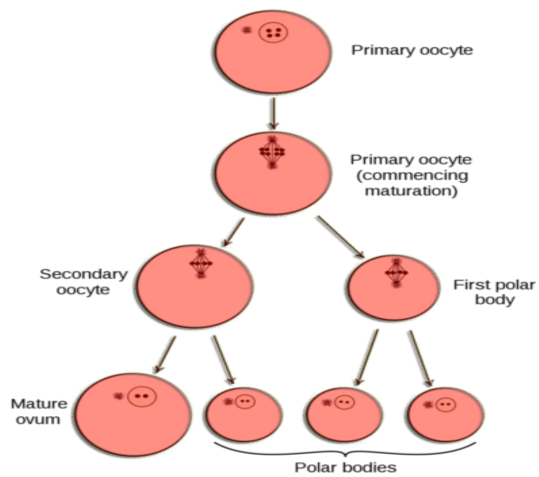
Each sperm cell has three parts: an oval head, a cylindrical middle piece, and an extended tail.

The head contains the nucleus. It is covered by a caplike structure called the acrosome. The acrosome stores enzymes that are needed to penetrate the protective layer surrounding a female egg.

The middle piece contains 50 to 100 mitochondria, which provide energy for the movement of the tail.

The tail propels the sperm with a lashing motion. The sperm can move at a rate of about 3 mm per hour. About 300 to 500 million sperm are produced each day in a male's lifetime.

Oogenesis



In female animals, meiosis takes place in the ovaries.

__________________________ process of female gamete production.

________________________ diploid germ cell from which ova are produced. Each oogonium undergoes mitosis to form two primary oocytes.

____ the oocyte that arises from the oogonium

_____________________________ a small haploid cell that is formed at the same time as an egg cell during oogenesis, but generally does not have the ability to be fertilized.

Each oogonium undergoes mitosis to form two primary oocytes.

About three months after conception, a female fetus has about two million primary oocytes in the ovaries.

____

____.

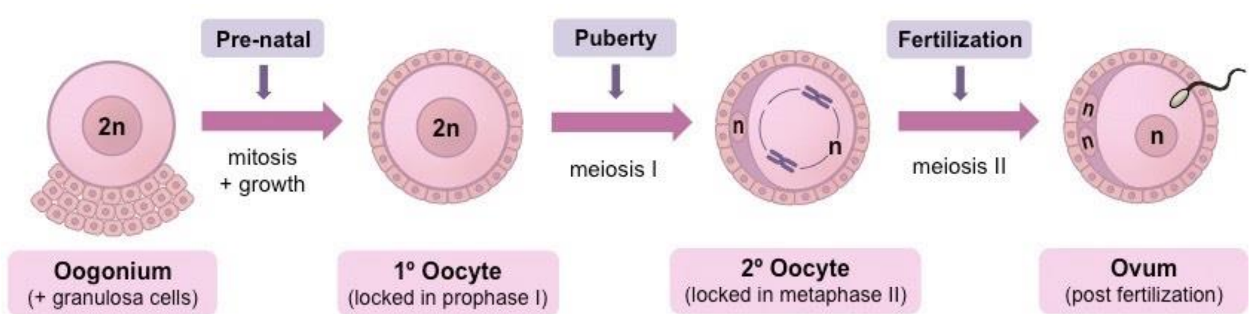
Every month after puberty, one primary oocyte undergoes meiosis.

Oogenesis involves an unequal division of cytoplasm

At the end of meiosis I, the cytoplasm is not equally divided between the two daughter cells.

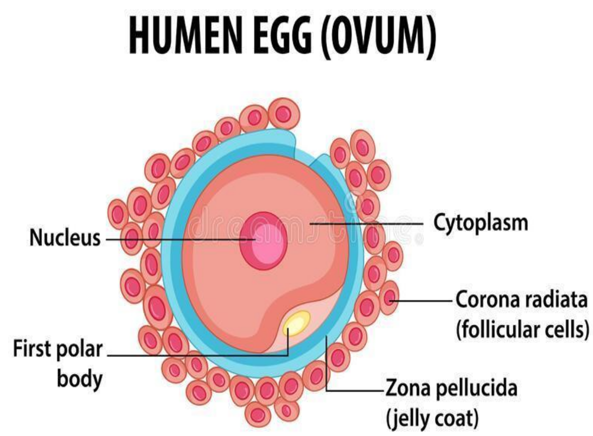
The cell that receives most of the cytoplasm is called the secondary oocyte.

The other cell is called the first polar body. The first polar body may or may not go through a second division to produce a pair of second polar bodies. In either case, the polar bodies are not functional and soon degenerate.



When the secondary oocyte undergoes meiosis II, the cytoplasm is again unequally divided.

The cell that contains most of the cytoplasm will eventually become a mature egg, or ovum (Ova plural). The other cell, another second polar body, is not a viable gamete.



The unequal division of cytoplasm means that only one egg cell is produced from the division of the secondary oocyte.

This egg cell contains a large quantity of nutrients that the zygote can use prior to implantation.

The primary oocytes begin meiosis I before birth, but cell division stalls in prophase I.

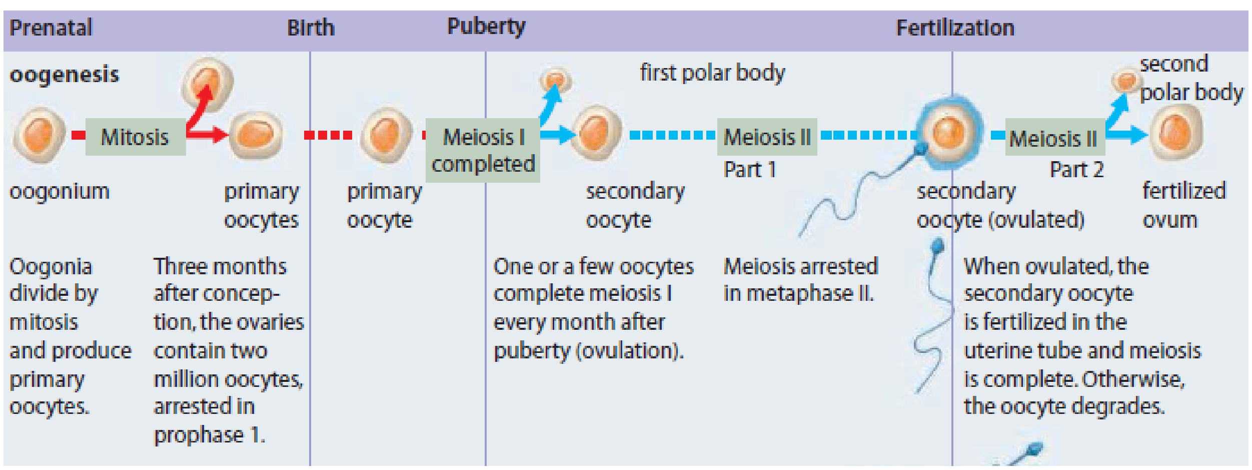
The cells remain in this suspended state until puberty.

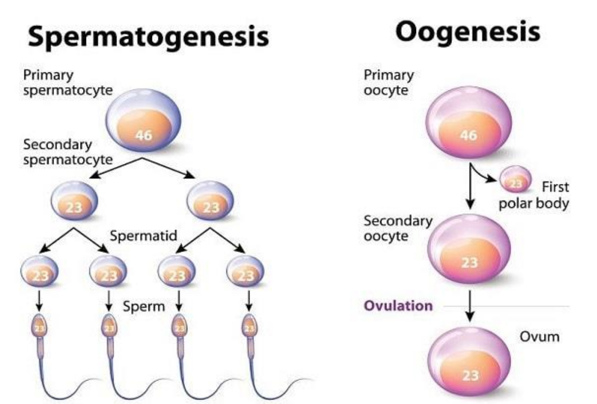
At puberty, a hormone signal triggers a single primary oocyte to resume meiosis. The primary oocyte completes meiosis I.

The secondary oocyte is then released from the ovary and travels down the Fallopian tube.

The secondary oocyte is arrested at metaphase II until fertilization occurs.

If the secondary oocyte does not come into contact with a sperm cell, it will not complete a second meiotic division. If it does come into contact with a sperm cell and fertilization occurs, it will complete meiosis II.



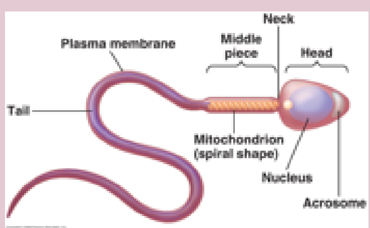
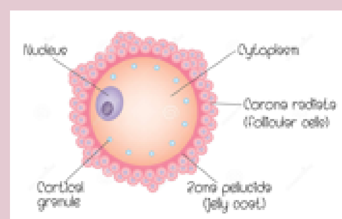


Ovum

A mature ovum is a non-motile, sphere-shaped cell approximately 0.1 mm in diameter (that is, over 20 times larger than the head of a sperm cell).

The ovum contains a large quantity of cytoplasm, which contains nutrients for the first days of development after fertilization.

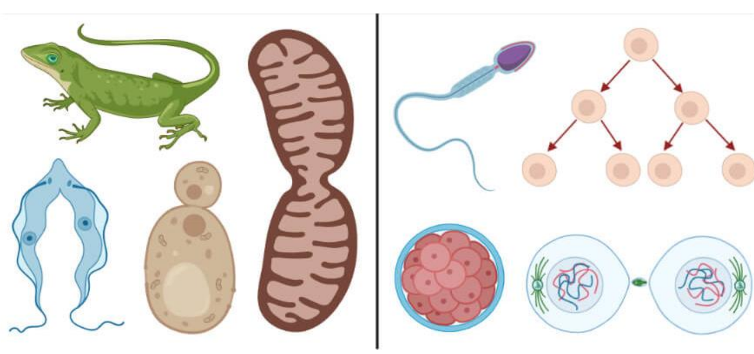
The cytoplasm contains about 140 000 mitochondria. The ovum is encased in a thick membrane that must be penetrated by a sperm cell before fertilization can take place.

	Sperm	Ovum
Size	0.05 mm	0.1 mm
Energy Reserve	None	Yes, nutrients in the cytoplasm
Mitochondria	50 to 100	140,000
How many	300-500 million each day	1 per cycle (month)
Motility	Yes	No
Special Structures	Acrosome Head Mid Piece Tail	Zona Pellucida: Thick outer membrane Cortical Granules: Enzyme packets in the cell
		

Reproductive Strategies

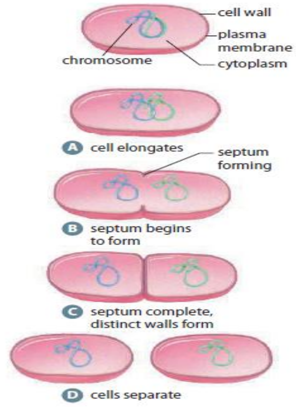
____ reproduction that requires only one parent

____ reproduction involving fertilization of gametes



Asexual Reproduction

____ asexual form of reproduction in prokaryotes (bacteria) that produces two identical cells



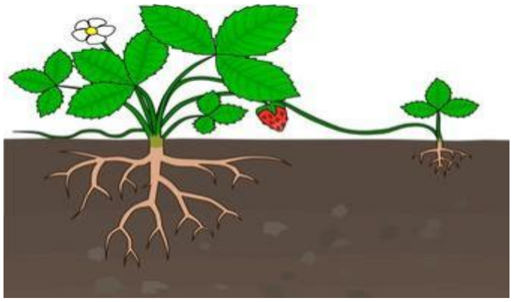
___________________________ a new organism develops from an outgrowth of the parent

The new organism then separates to become an independent organism.

Example: Hydra

Figure 12.20 This *Hydra* is reproducing by budding. The species can also reproduce sexually.

____ growth of a new plant from a modified stem



Strawberry plants can spread across a garden by extending thin creeping stems. A new strawberry plant develops at the end of each stem.

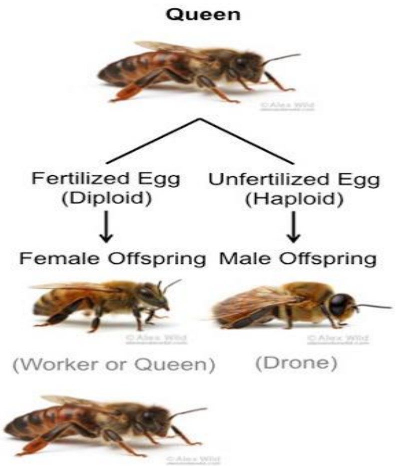
Once the new plant has taken root, the stem disintegrates, separating the new plant from its parent.

____ a new organism forms from a part of a parent

In the cultivation of potatoes, for example, entire new plants are grown from a fragment, or tuber, of a parent plant.

Gardeners rely on fragmentation to propagate new garden plants from cuttings.

Some animals, such as sea stars, can reproduce by fragmentation.

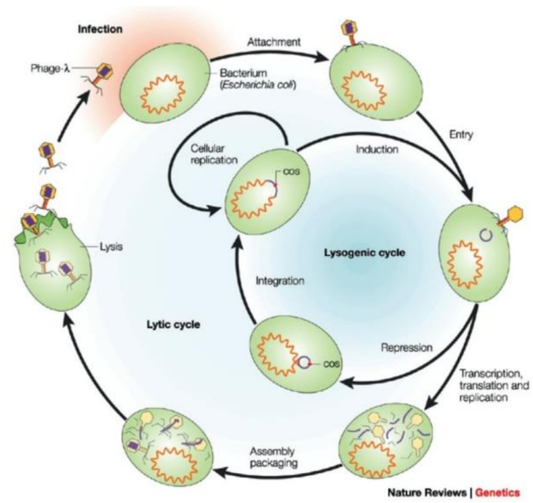


_______________________________________ development of an adult organism from an unfertilized egg

In honeybees, for example, the queen bee lays both fertilized and unfertilized eggs. The fertilized eggs develop into female worker bees, while the unfertilized eggs develop into male drones. The whiptail lizard (Cnemidophorus neomexicanus) is another animal that reproduces by parthenogenesis.

___________________________ reproductive cell able to develop into a new organism

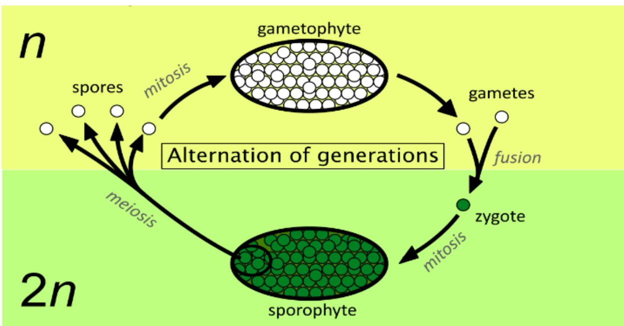
Mushrooms, Mosses, Liverworts, Hornworts and Ferns



Virus Reproduction

The _____________________________ involves the reproduction of viruses using a host cell to manufacture more viruses; the viruses then burst out of the cell.

The ______________________________________ involves the incorporation of the viral genome into the host cell genome, infecting it from within

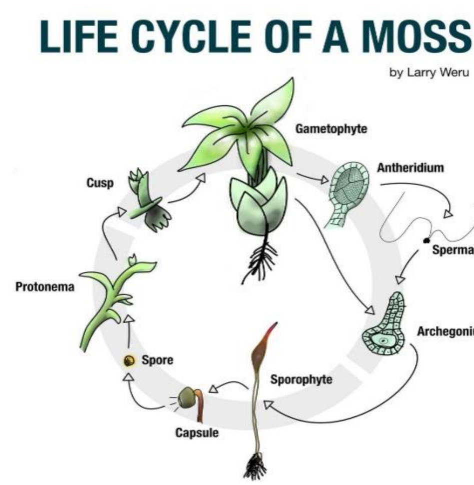


Alternation of Generations

____

____ the life cycle of plants consists of two generations: a haploid generation and a diploid generation that alternate. The diploid generation of a plant is called the sporophyte (spore-making body). Through the process of meiosis, the sporophyte produces one or more haploid spores. These spores develop without fertilization. Each haploid spore grows into a plant body called the gametophyte (gamete-making body). Gametophytes produce male and female gametes, which fuse at fertilization and develop into another sporophyte.

Life Cycle of a Moss



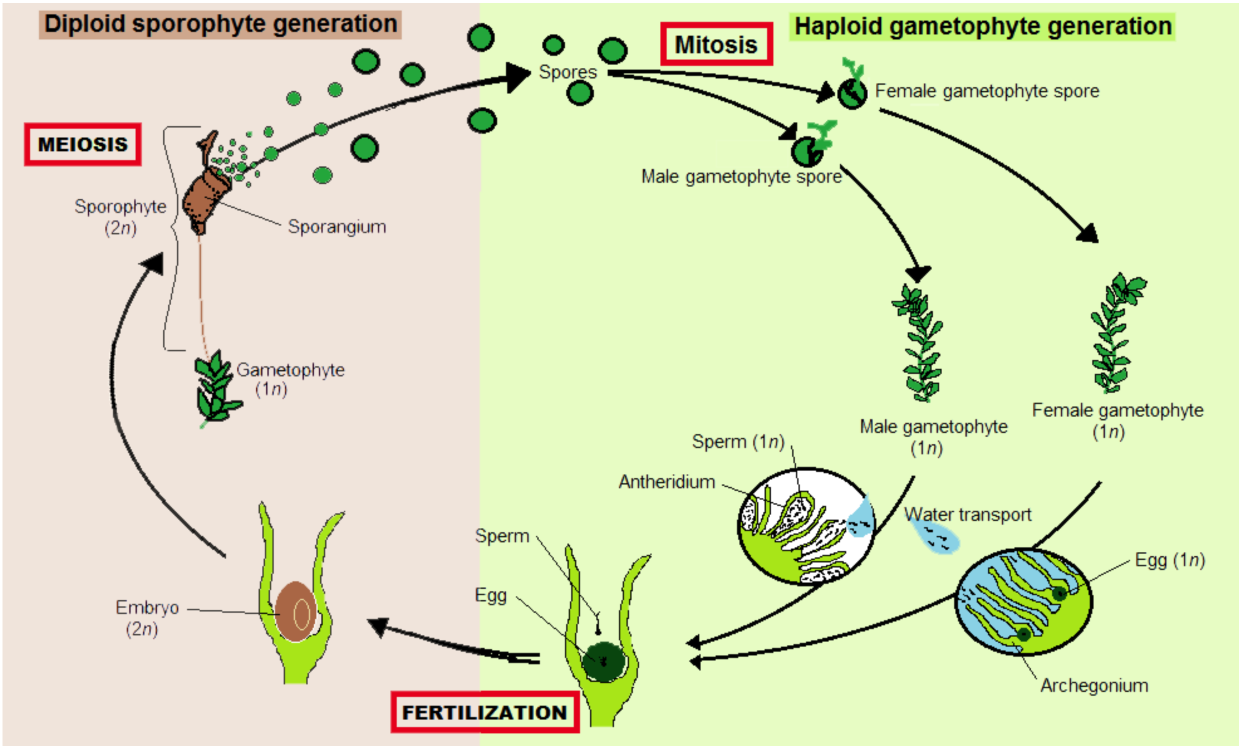
The life cycle of most mosses begins with the release of spores from a capsule, which opens when a small, lid like structure, called the operculum, degenerates.

A single spore germinates to form a branched, filamentous protonema, from which a leafy gametophyte (n) develops.

The gametophyte bears organs for sexual reproduction. Sperm, which are released by the mature antheridium (the male reproductive organ), are attracted into the neck of an archegonium (the female reproductive organ).

Here, one sperm fuses with the egg to produce the zygote. After cell division, the zygote becomes the sporophyte (2n), and, at the same time, the archegonium divides to form the protective calyptra.

The sporophyte usually consists of a capsule and a seta. Asexual reproduction occurs within the capsule and the whole process may begin again.

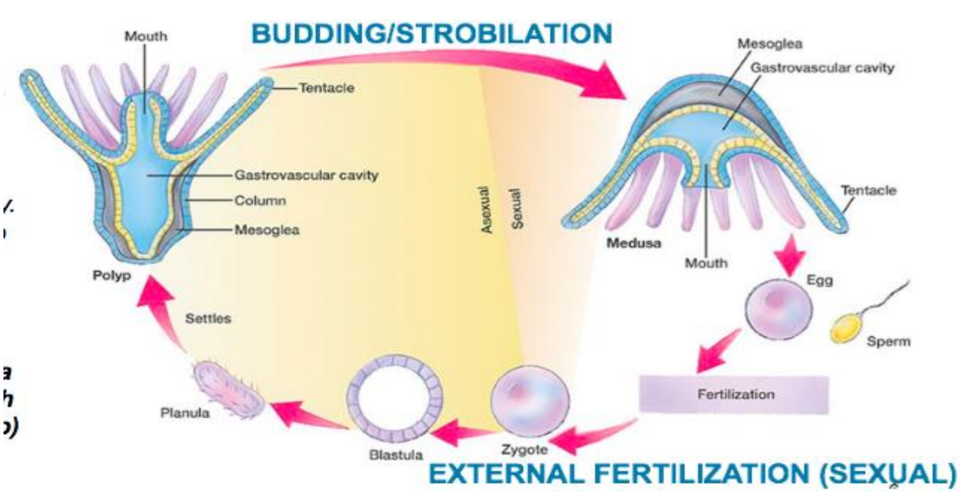


Life Cycle of Cnidaria

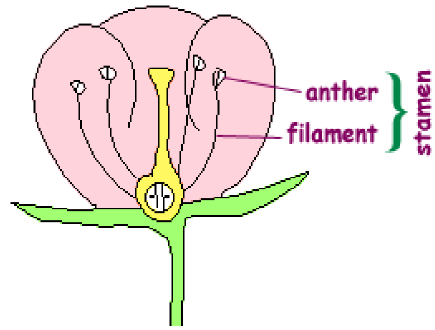
Cnidarians have separate sexes and many have a lifecycle that involves two distinct morphological forms—medusoid and polypoid—at various stages in their life cycles.

In species with both forms, the ____, gamete-producing stage and the ____.

Jellyfish



Sexual Reproduction in Flowering Plants

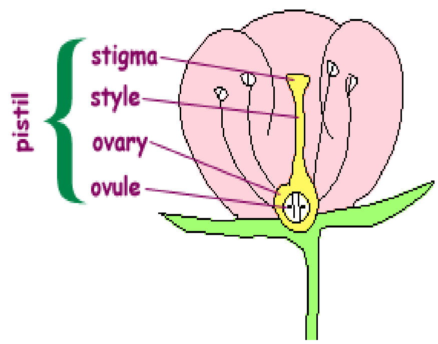


____________________________ the male reproductive organ in flowering plants

A stamen is composed of a ________________________ and the ________________________. The filament supports the anther, which contains cells that undergo meiosis and mitotic cell divisions to form pollen grains.

Two sperm eventually form inside each pollen grain.

pollen (male gametophyte)



__________________________ the female reproductive organ in flowering plant

In the centre of a flower are one or more pistils. A pistil usually has a stigma, a style, and an ovary.

The _______________________ is the tip of the pistil and is the place where pollination takes place.

The _______________________ connects the stigma to the _____________________, which contains one or more ovules.

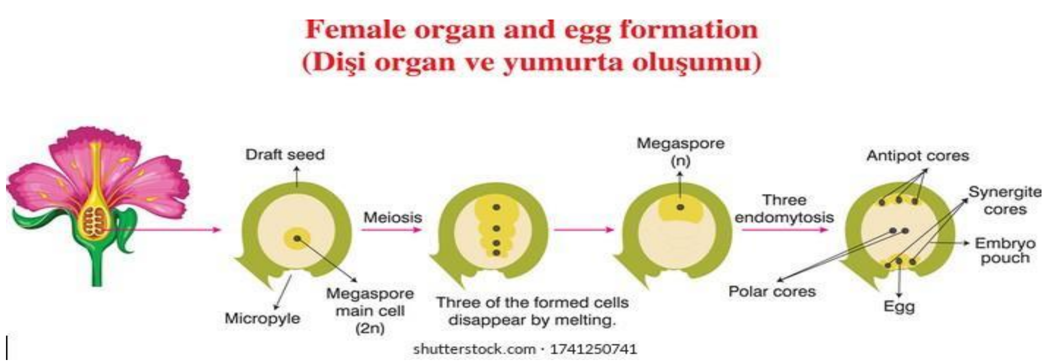
A female gametophyte develops in each ______________________, and an egg forms inside each female gametophyte.

Life Cycle of a Flowering Plant

The development of male and female gametophytes begins in an undeveloped flower.

Inside the flower's ovary, an ovule containing the embryo sac begins to grow. Inside the ovule, meiosis results in four ____. Usually, three of the four megaspores disintegrate, leaving ____.

Mitosis occurs in the remaining __________________________________ three times, until the one megaspore contains eight haploid nuclei divided into seven cells. One of the cells contains two nuclei, which are called ____.

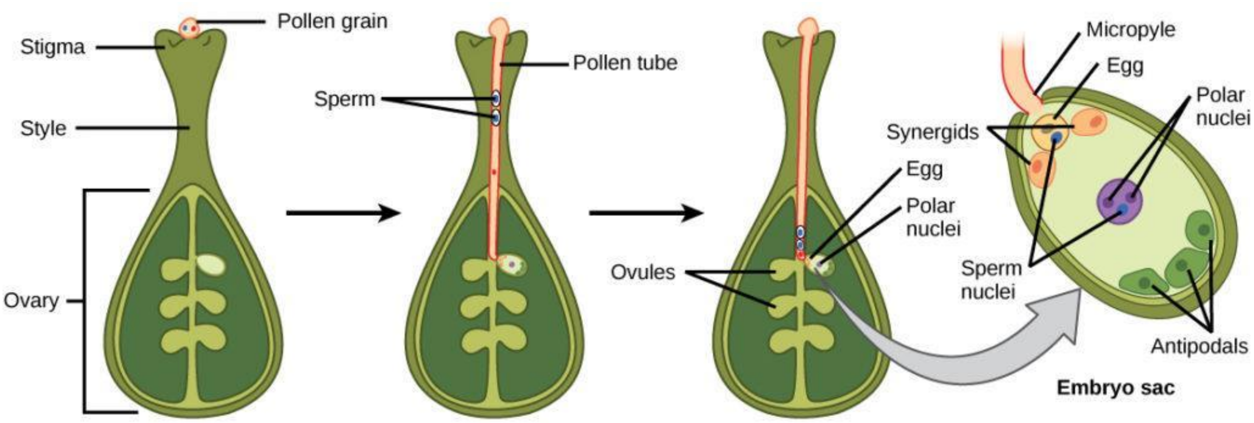


In the ________________________________, specialized cells undergo meiosis to produce microspores. Each ________________________________ undergoes mitosis to form a tube cell and a generative cell. A thick, protective cell wall forms around a microspore.

At this point, the microspore is an immature male gametophyte, which is called a ___________________________. Pollen is _______________________.

When the pollen grain lands on a stigma of the correct species, the _______________________________ forms a __________________________________. As the pollen tube grows, the ____ undergoes mitosis, forming two sperm cells. The pollen grain is now a mature male gametophyte.

When the pollen tube reaches the ovule, it releases the two sperm cells. One fuses with the egg, forming the zygote (___________________)—the new sporophyte. The other fuses with the __________________________________, forming a ___________________ (   ) cell that divides to form a nutrient-rich tissue called ________________________________. The endosperm nourishes the embryo as it grows. The fertilization of an angiosperm egg is called ____, because two fertilizations occur. After fertilization, the _______________________ develops into the ____________________ and the ____________________ develops into the ______________________.

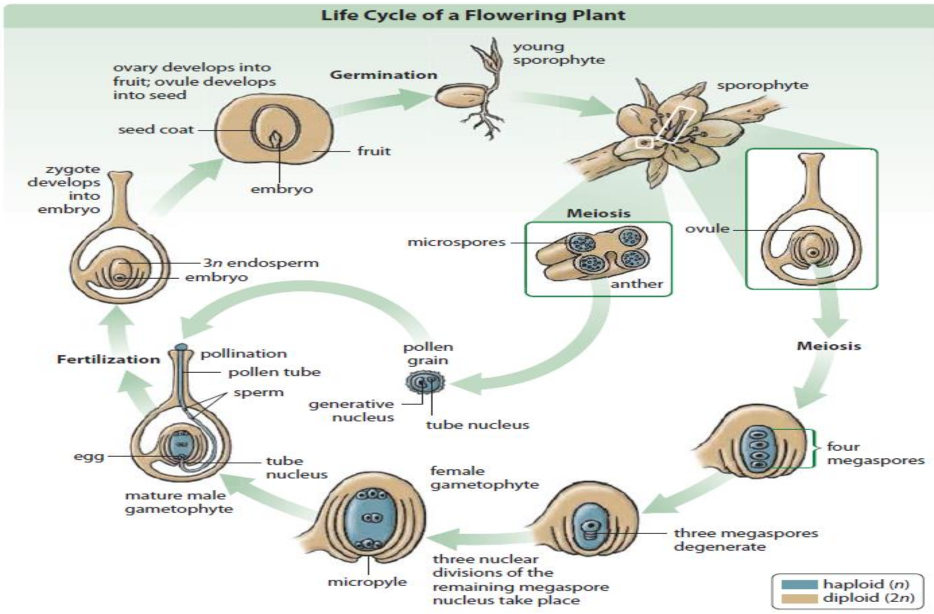


The pollen grain adheres to the stigma, which contains two cells: a generative cell and a tube cell.

The pollen tube cell grows into the style. The generative cell travels inside the pollen tube. It divides to form two sperm.

The pollen tube penetrates an opening in the ovule called a micropyle.

One of the sperm fertilizes the egg to form the diploid zygote. The other sperm fertilizes two polar nuclei to form the triploid endosperm, which will become a food source for the growing embryo.



Advantages and Disadvantages of Reproductive Strategies

Sexual Reproduction	
Advantages	**Disadvantages**
Sexual reproduction offers a population a way to **adapt to a changing environment**. At least some offspring, for example, may have a greater ability to resist parasites or toxins in the environment or to take advantage of new food sources.	Costs Energy
Competition among siblings may be **reduced** if they are genetically diverse.	Risk of Genetic Problems
Pairing of homologous chromosomes and crossing over offer opportunities to **replace or repair damaged chromosomes**.	Time spent searching for mate
	May not be as adapted as the parent

Asexual Reproduction	
Advantages	**Disadvantages**
Asexual reproduction often proceeds more quickly than sexual reproduction, and it does not require the presence of a second parent organism.	Low genetic variation
Asexual reproduction usually requires less energy than sexual reproduction.	Adaptation to the environment is difficult
Many forms of asexual reproduction, such as vegetative reproduction and budding, help to maximize the chances that individual offspring will survive. In these forms of asexual reproduction, the daughter organism does not fully separate from the parent until it is capable of independent survival.	Slows evolution
	Disease is likely to affect the entire population

Flower Dissection Lab