

4.1 The Nature of Heredity

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Genetics: the study of _____ and variation.

_____: the passing of traits from parents to their offspring.

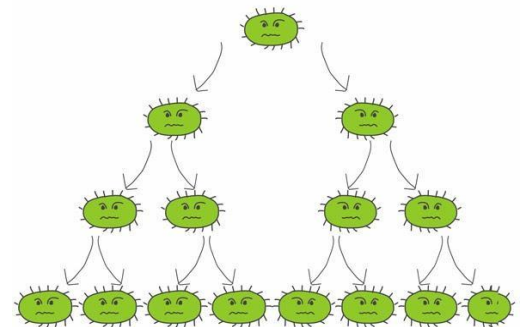
- _____ are long coiled strands of DNA (deoxyribonucleic acid) found in the nucleus of eukaryotic cells
- Each chromosome contains _____ of genes.
- Genes are segments of DNA that code for a particular _____.
- An allele is a variant form of a gene. Some genes have a variety of different forms, which are located at the same position, or locus, on a chromosome

Chromosomes

- occur mostly in sets in multicellular organisms.
- _____ cells contain the normal number of chromosomes (2n)
- _____ cells have half the normal number of chromosomes (n)
- polyploid cells contain three or more sets of chromosomes.

Asexual Reproduction

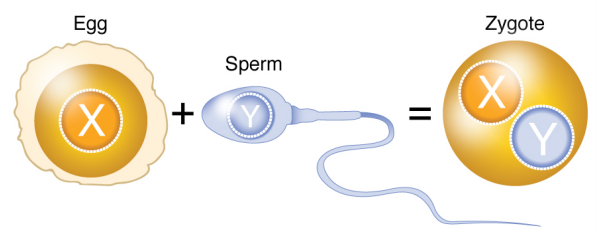
- The production of offspring from a _____ parent by cell division (without the use of sex cells)
- Advantages:
 - Do not need to seek out a mate (limit energy expenditure and risky activity)
 - Nothing left to chance - identical (invariability of offspring)
- Disadvantages
 - Little variation - if the environment changes, individuals may no longer be well adapted



Sexual Reproduction

- Offspring are produced from the _____ of two sex cells, usually coming from two different parent organisms.
- Advantages:
 - _____ of offspring (non-identical) - If the environment changes, some individuals may be better able to adapt.
- Disadvantages:
 - Need to have different sexes, mating calls or mating dances, etc.
 - Sex is biologically _____ - attracting a mate can also attract predators (ie. bright coloured peacock).

Pg 141: # 1,5,6 & 7



4.2 Asexual Reproduction

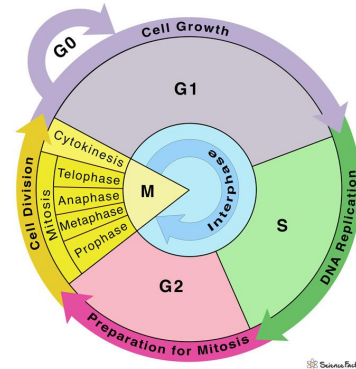
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Modes of Asexual Reproduction

- Strawberry plants can send out “_____”.
- Hydra can produce offspring by outgrowths of their bodies called “_____”.
- Female aphids produce female offspring (without a male) in the spring.
- Fungi can reproduce through _____, when a piece breaks off and becomes independent.

Cell Division

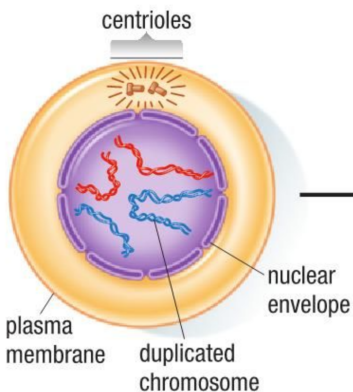
- Cell Division - a necessity for reproduction
- Cell division consists of both mitosis and cytokinesis
 - _____: nuclear
 - _____: cytoplasmic



division
division

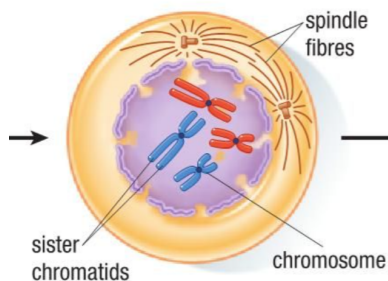
Stages of Mitosis

MITOSIS



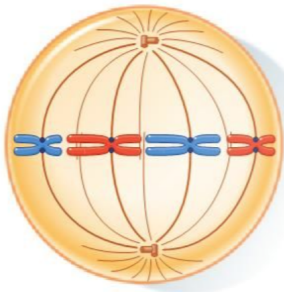
Interphase:

- (longest phase of cell cycle)
- Cell grows and carries out _____ functions
- Genetic material is in the form of thread-like _____
- Replication of chromosomes results in pairs of sister chromatids attached at the centromere (same genes at the same loci).



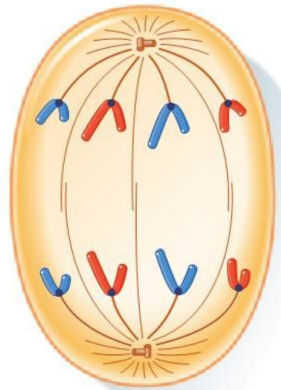
Prophase:

- Prophase is the first phase of mitosis
- During prophase the chromosomes condense and are visible under a microscope.
- _____ (in animal cells) separate and move to opposite ends of the cell
- Nuclear membrane starts to dissolve



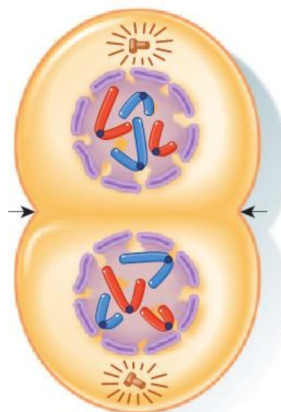
Metaphase:

- Centrioles organize spindle fibres
- Centromere anchors the spindle fibre
- Metaphase is the second phase of mitosis
- Spindle fibers move and align _____ (each composed of sister chromatids) in the centre (equator) of the cell.



Anaphase:

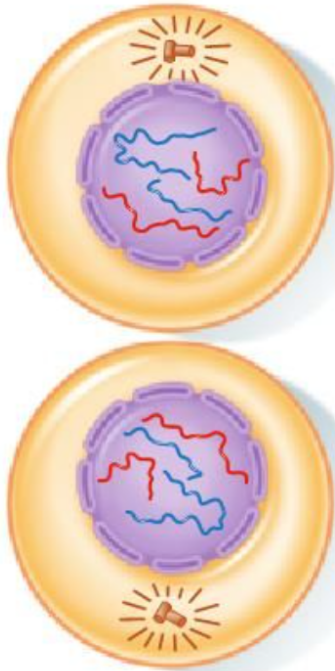
- This is the third phase of mitosis
- Centromeres divide
- Sister chromatids(chromosomes) separate and move to _____ poles of the cell
- If mitosis proceeds correctly, the same number and type of chromosomes will be found at each pole of the cell.



Telophase:

- This is the last phase of mitosis
- Chromosomes reach opposite poles of the cell and begin to unwind
- Spindle fibres dissolve
- Nuclear membrane forms around _____

CYTOKINESIS



- Mitosis is immediately followed by _____, when the cell divides its cytoplasm and organelles, into two new daughter cells
- In many cells (protist, fungi and animal) a _____ develops
- In plant cells, vesicles produced by golgi apparatus gather, then fuse, on both sides of the equator; this cell _____ will then become the cell wall

Biotechnology

Biotechnology is the field of biology that involves the use of living things in engineering, industry and medicine.

Plant Cloning

- In 1958, carrot plants were first cloned using single carrot cells
- Commonly used to produce strains of plants with identical characteristics

Animal Cloning

- In 1996, Dolly was the first mammal to be cloned
- Removed _____ cell from sheep to be cloned
- Removed nucleus from egg cell of an egg donor
- Fused body cell with _____ egg cell and stimulated the egg cell to grow and differentiate.
- Inserted cell into the uterus of third sheep (surrogate mother)
- Dolly was born 5 months later!

Animal Cloning - Implications

- Shorter lifespan and premature aging (e.g. Dolly had arthritis)
- Suffer from a variety of _____ implications (e.g. Dolly had lung problems).

Applications and implications of Cloning

- _____ production of high quality livestock and crop plants
- Implications: expensive, lack variation

- Cloning genetically _____ organisms
 - Ex. Human _____ gene inserted into safflower plants
- Cloning endangered species offers alternative when captive breeding proves difficult
- Cloning extinct organisms difficult because of lack of DNA

4.2 Homework: Pg 151: #1, 2 & 6

4.3 Sexual Reproduction

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Sexual Reproduction

- Unlike asexual reproduction, sexual reproduction produces genetic _____ .
- It involves two key processes:
 1. Formation of _____ sex cells called gametes
 2. Fertilization - when the sex cells join to form a _____

Modes of Sexual Reproduction

- The sex cells (gametes) of different organisms vary considerably but most species produce two types.
- In animals, _____ produce sperm and ovaries produce egg cells.
- Plants (inc. mosses and ferns) also produce gametes
- in higher plants, gametes are produced in _____ and flowers and sperm is spread as pollen grains
- Many species have male and female individuals while others are _____ .

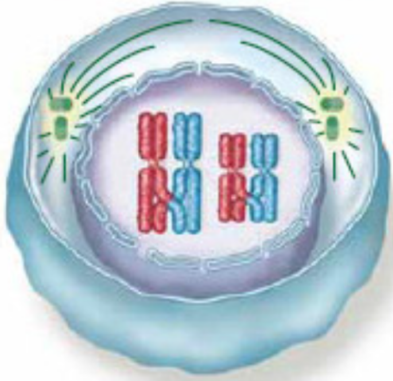
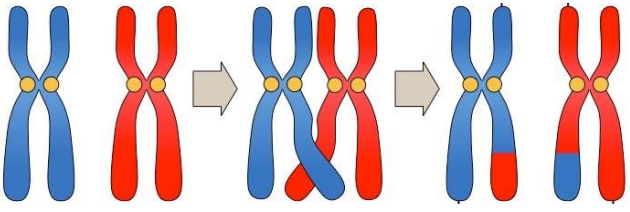
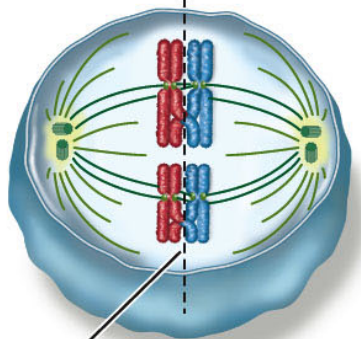
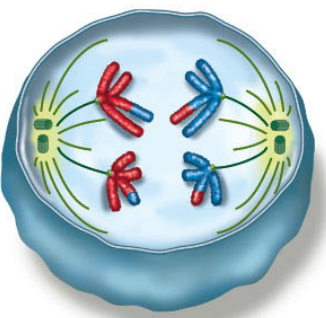
Sexual reproduction depends on meiosis

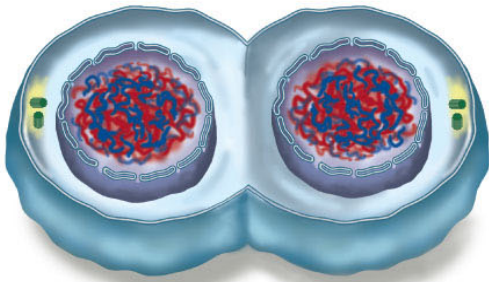
- It is a two stage division in which the resulting _____ cells have half the number of chromosomes (haploid) as the parent cell
- Results in the formation of gametes.

Homologous pairs

- Humans receive one set of DNA from an _____ cell, and one set of DNA from a sperm cell.
- As a result, all our somatic cells have 23 PAIRS of chromosomes
- We call these pairs _____ PAIRS.
 - Have similar structural features (e.g. size, banding patterns, centromere positions)
 - Have the same _____ at the same loci position
 - while the genes are the same, _____ , a form of a gene, may be different
 - Alleles help account for different traits
- Pair up with each other during _____

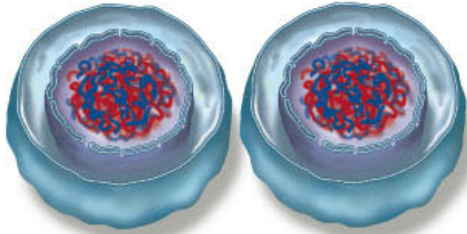
Steps in Meiosis - How gametes (haploid sex cells) are produced

	<p>Prophase 1</p> <ul style="list-style-type: none">• Chromosomes condense• Crossing over occurs <p>During synapsis, crossing over occurs between non-sister chromatids - they exchange segments.</p> <ul style="list-style-type: none">• This results in _____! 
 <p>Equatorial plate</p>	<p>Metaphase 1</p> <ul style="list-style-type: none">• Chromosomes (homologous pairs) line up at equatorial plate
	<p>Anaphase 1</p> <ul style="list-style-type: none">• _____ pairs separate• Move to opposite ends of cell



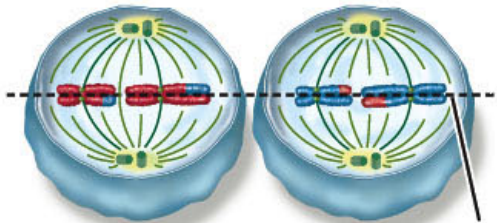
Telophase 1

- Nucleus completes division
- Nuclear membrane reforms
- Cleavage furrow



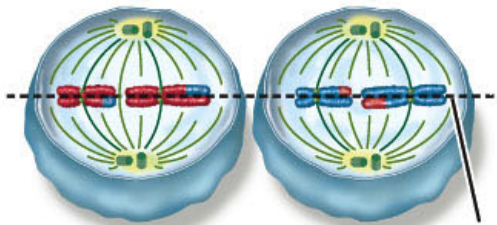
Prophase 2

- New spindle fibers form
- Chromosomes _____



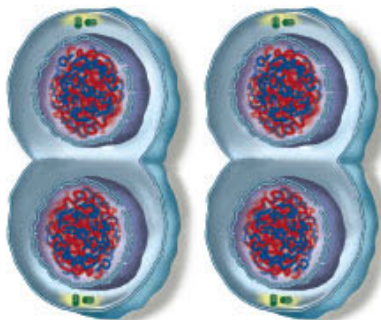
Metaphase 2

- Chromatids line up at the _____ plate



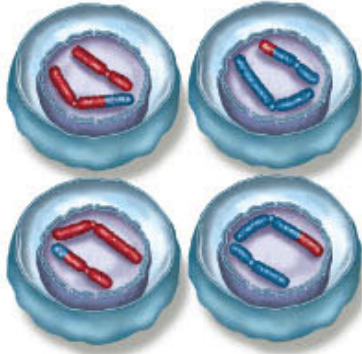
Anaphase 2

- _____ separate



Telophase 2

- _____ separates



Product of meiosis:

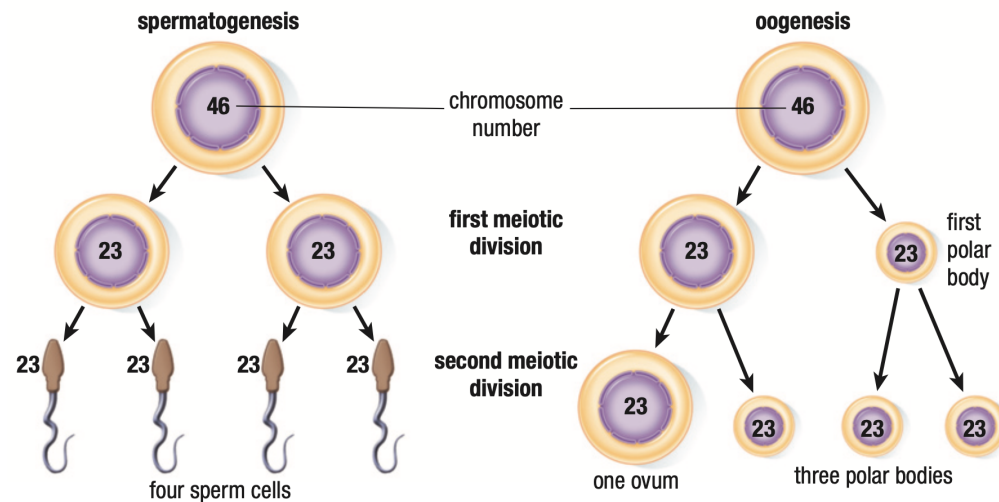
- Result is 4 _____ cells
- Haploid cells have half the number of chromosomes as parent cell

Random Assortment of Homologous Chromosomes

- Random assortment occurs in _____1
 - Random line up of homologous chromosome pairs at the cell's equator helps to ensure _____.
- The number of possible combinations of chromosomes depends on the # of chromosome pairs.
- For diploid (2n) organisms, the number of possible combinations is 2^n
 - For humans, the number of possible combinations is $2^{23} = 8388608!$

Gametogenesis

- Gametogenesis: the production of _____(sex cells) in animals
- _____: production of mature sperm cells
- _____: the production of mature egg cells
 - In oogenesis, cytoplasm does not divide evenly
 - Cells that don't receive enough cytoplasm are called polar bodies
 - One cell (ovum) is produced



Types of Cells

- Somatic Cells - Human somatic cells have 46 chromosomes (23 pairs of chromosomes) said to be diploid ($2n$) because they have double the number of chromosomes as gametes.
 - Most reproduce by mitosis
- The n value of a cell tells you how many PAIRS of chromosomes that cell has. $2n$ = how many chromosomes there are total. So for humans, $2n$ for our somatic cells = 46
- Gametes - Reproductive cells have 23 chromosomes and are said to be haploid (n) because they have half the number of chromosomes as somatic cells.
 - n = the haploid number of chromosomes in a species;
 - for humans, $n=23$
 - Must be produced by special cells in the ovaries/testes through meiosis

Sex chromosomes

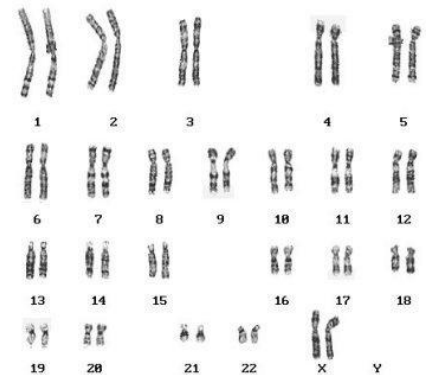
- In females, sex chromosomes consist of a matching pair of _____chromosomes (XX)
- In males, sex chromosomes consist of a _____matching pair (XY) one is much smaller than the other. The larger of the two is a homologue to the sex chromosome in the female (X)

Sex Determination Methods

- Some species have different systems to determine sex (other than the XX/XY system):
- For some reptiles - sex of offspring is _____ dependent
- Some fish are born female then become male or vice-versa

Karyotype

- A karyotype is a _____of an individual's chromosomes that have been sorted and arranged according to size and type
- Note there are 1 pair of sex chromosomes, the other 22 pairs are autosomal chromosomes.



Karyotypes - Uses

- Karyotypes can be used to look for abnormal numbers or structures of chromosomes.
- A karyotype is an individual's collection of chromosomes.
- The term also refers to a laboratory technique that produces an image of an individual's chromosomes.
- The karyotype is used to look for _____numbers or structures of chromosomes.

How are karyotypes made?

- Technicians remove a small sample of _____(i.e. blood or amniotic fluid)

- Mix it with a solution that stimulates mitosis
- Colchicine is added to stop the cells in _____ and the sample is placed on a slide
- A stain is added to make light and dark bands appear on the chromosomes and a photograph is taken
- The chromosomes are cut out and arranged in homologous pairs

Homework:

- Pg. 160 #3-9, 11