**Meiosis Study Guide**

# The Cell Cycle

## The cell cycle has 2 main phases.

### Interphase

### Cell Division (Meiosis or Mitosis).

## Interphase is separated into 3 phases :

### G1 – cell grows in size, doubles it cytoplasmic contents

#### Genetic inventory for G1

##### The human cell in G1 has 2 sets of 23 chromosomes.

##### 1 set of 23 chromosomes comes from Mom and 1 set of 23 chromosomes comes from Dad.

##### The total number of chromosomes = 46

##### There are 0 sister chromatids (no chromosome duplication has occurred yet)

### S-Phase – DNA is synthesized. The genetic material is duplicated BUT NOT SEPERATED.

#### Genetic inventory for S-Phase

##### The human cell at the end of S-Phase has 2 sets of 23 chromosomes **that are now shaped like an ‘X’ (a tetrad).**

##### 1 set of 23 chromosomes from Mom **that are now shaped like an ‘X’ (a tetrad)** and 1 set of 23 chromosomes **that are now shaped like an ‘X’ (a tetrad)** from Dad.

##### The total number of chromosomes = 46 chromosomes **that are now shaped like an ‘X’ (a tetrad). [ 2 X 23 = 46 ]**

##### The chromosome at this point are each made up of 2 genetically identical sister chromatids.

##### There are 92 total sister chromatids , because there are 46 total chromosomes. [ 2 X 46 = 92]

### G2 – cells grows in size again and prepares for cell division (Meiosis or Mitosis)

#### Genetic inventory for G2 IS IDENTICAL TO S-PHASE!

##### The human cell at the end of S-Phase has 2 sets of 23 chromosomes **that are now shaped like an ‘X’ (a tetrad).**

##### 1 set of 23 chromosomes from Mom **that are now shaped like an ‘X’ (a tetrad)** and 1 set of 23 chromosomes **that are now shaped like an ‘X’ (a tetrad)** from Dad.

##### The total number of chromosomes = 46 chromosomes **that are now shaped like an ‘X’ (a tetrad). [ 2 X 23 = 46 ]**

##### The chromosome at this point are each made up of 2 genetically identical sister chromatids.

##### There are 92 total sister chromatids , because there are 46 total chromosomes. [ 2 X 46 = 92]

# Meiosis Vs Mitosis

# Immediately following G2, the cell will undergo cell division (Meiosis or mitosis).

# Cells that are sex cells or gametes (sperm or eggs), will undergo meiosis. All other cells in the body undergo mitosis.

|  |  |
| --- | --- |
| MITOSIS | MEIOSIS |
| Produces 2 Daughter Cells | **Produces 4 Daughter Cells** |
| Cell Division in Non-Gametes | **Cell Division in Gametes** |
| Offspring are Clones (Genetically Identical) | **Offspring are Genetically Unique** |
| Daughter Cells are Diploid | **Daughter Cells are Haploid** |
| Asexual Reproduction | **Sexual Reproduction** |

|  |  |  |
| --- | --- | --- |
| **Mitosis** | **Meiosis I** | **Meiosis II** |
| **Prophase** | Prophase I | Prophase II |
| **Begins with Diploid Parent Cell = 46 chromosomes (2 sets of 23 chromosomes)** | Begins with Diploid Parent Cell = 46 chromosomes (2 sets of 23 chromosomes) | Begins with the 2 Haploid Daughter Cells Formed in Meiosis I. Each of these has 23 chromosomes (only 1 set of 23 chromosomes that is a mixture of Mom’s and Dad’s DNA) |
| **Chromosomes condense, mitotic spindle appears, nuclear membrane breaks up.** | Chromosomes condense, mitotic spindle appears, nuclear membrane breaks up.Homologous chromosomes pair up and Crossover occurs. | Both of the Daughter Cells Formed in Meiosis I will undergo Meiosis II.In both daughter cells, Chromosomes condense, mitotic spindle appears, nuclear membrane breaks up. |
| **Metaphase** | Metaphase I | Metapahse II |
| **All 46 Chromosomes Line up at the Middle (Single File)** | Homologous Pairs of Chromosomes Line Up at the Middle (Double File, making 23 Pairs) | (in both daughter cells) All 23 Chromosomes Line up at the Middle (Single File) |
| **Anaphase** | Anaphase I | Anaphase II |
| **Sister Chromatids are Pulled to Opposite Side of the Cell (46 sister chromatids go to one side and 46 sister chromatids go to the other side).** | Homologous Chromosomes are Pulled to Opposite Side of the Cell (23 chromosomes go to one side and the other 23 chromosomes go to the other side). | (in both daughter cells) Sister Chromatids are Pulled to Opposite Side of the Cell (in both daughter cells). (23 sister chromatids go to one side and 23 sister chromatids go to the other side). |
| **Telophase** | Telophase I | Telophase II |
| **One Cell Prepares to Split Into Two Daughter Cells each having 46 sister chromatids which will become chromosomes in the new cell.** | One Cell Prepares to Split Into Two Daughter Cells each containing only 23 chromosomes total. They are now HAPLOID. | (in both daughter cells) Each of the Cells Prepares to Split Into Two Additional Daughter Cells to Make 4 Total Daughter Cells. Each of the Daughter Cells will have 23 sister chromatids which will become the 23 chromosomes in the new cell. |
|  |  |  |
|  |  |  |

# OVERVIEW OF MEIOSIS

## Meiosis is composed of

### Meiosis I

### Meiosis II

## Meiosis I consists of

### Prophase I

### Metaphase I

### Anaphase I

### Telophase I

## Meiosis II consists of

### Prophase II

### Metaphase II

### Anaphase II

### Telophase II

# The Phases of Meiosis I and II

## Early Prophase I

### Chromosomes condense becoming visible

### Nuclear Envelope Breaks Up

### Mitotic Spindle (Spindle Apparatus) Forms

## Late Prophase I

### Mitotic spindle attaches to the kinetochores of homologous chromosomes

### Mitotic spindle pairs up homologous chromosomes side-by-side

### Crossing Over occurs

#### Genetic material is swapped between homologous chromosomes

## Metaphase I

### After crossing over, the mitotic spindle lines up the pairs of homologous chromosomes at the middle of the cell.

## Anaphase I

### The mitotic spindle pulls homologous chromosomes to opposite sides of the cell. (One to one side and the other to the other side).

## Telophase I

### Nuclear envelope begins to reform

### Mitotic spindle breaks up

### Chromosomes decondense

### Ends when cytokinesis pinches the one cell into 2 daughter cells that are haploid.

## Prophase II

### Both Haploid Daughter Cells from meiosis I Immediately Enter the Phases of Meiosis II

### Chromosomes condense becoming visible

### Nuclear Envelope Breaks Up

### Mitotic Spindle (Spindle Apparatus) Forms

### *Notice that there is no cross over event or pairing of homologous chromosomes as we saw in Prophase I*

## Metaphase II

### The mitotic spindle lines up the individual chromosomes at the middle of the cell in single file

### *Notice that it is single chromosomes that are lined up and NOT homologous pairs of chromosomes lined up as we saw in Metaphase I*

## Anaphase II

### The mitotic spindle Sister Chromatids to opposite sides of the cell. (One to one side and the other to the other side).

### *Notice that it is the sister chromatids that are pulled to opposite sides of the cell and NOT homologous chromosomes as we saw in Anaphase I*

## Telophase I

### Nuclear envelope begins to reform

### Mitotic spindle breaks up

### Chromosomes decondense

### Ends when cytokinesis pinches each of the daughter cells into 2 additional daughter cells that are haploid gametes (sperm or eggs) to make 4 total gametes

# The Purpose of Meiosis

## The purpose of Meiosis is to create genetic variation in the offspring.

### Genetic Variation in Offspring is Produced By

#### Crossover (Crossing Over) during Prophase I

#### Independent Assortment

##### Each time a cell divides, each chromosome has a 50?50 chance of ending up in the daughter cell on the left vs. the one on the right.

### To Form a Zygote having 2 full sets of chromosomes

#### The egg that made you had 1 set of 23 chromosomes that was a mixture of your Mom’s Parent’s DNA

#### The sperm that made you had 1 set of 23 chromosomes that was a mixture of your Dad’s Parent’s DNA

Vocabulary

### CELL BIOLOGY GLOSSARY - INDEX

[Anaphase](https://www.thoughtco.com/anaphase-a-cell-biology-definition-373298) - [stage in mitosis](https://www.thoughtco.com/stages-of-mitosis-373534) where chromosomes begin moving to opposite ends (poles) of the cell.

[Allele](https://www.thoughtco.com/allele-a-genetics-definition-373460) - an alternative form of a gene (one member of a pair) that is located at a specific position on a specific chromosome.

[Cell Cycle](http://biology.about.com/od/mitosisglossary/g/cellcycle.htm) - the life cycle of a dividing cell. It includes Interphase and cell division (Meiosis or Mitosis)

[Centrioles](https://www.thoughtco.com/centrioles-373538) – Proteins that give rise to the mitotic spindle

[Centromere](https://www.thoughtco.com/centromere-373539) - a region on a chromosome that joins the two sister chromatids together.

[Chromatid](https://www.thoughtco.com/chromatid-373540) - one of two copies of a replicated chromosome.

[Chromatin](https://www.thoughtco.com/chromatin-373461) - mass of genetic material composed of [DNA](https://www.thoughtco.com/dna-373454) and [proteins](https://www.thoughtco.com/proteins-373564) that condense to form chromosomes during eukaryotic cell division.

[Chromosome](https://www.thoughtco.com/chromosome-373462) - a long, stringy aggregate of genes that carries heredity information (DNA) and is formed from condensed chromatin.

[Cytokinesis](https://www.thoughtco.com/cytokinesis-in-a-cell-cycle-373541) - division of the cytoplasm that produces distinct daughter cells.

[Cytoplasm](https://www.thoughtco.com/cytoplasm-defined-373301) - consists of all of the contents outside of the nucleus and

[Daughter Cell](https://www.thoughtco.com/daughter-cells-defined-4024745) - a cell resulting from the replication and division of a single parent cell.

[Daughter Chromosome](https://www.thoughtco.com/daughter-chromosome-373542) - a chromosome that results from the separation of sister chromatids during cell division.

[Diploid Cell](https://www.thoughtco.com/diploid-cell-373464) - a cell that contains two sets of chromosomes. One set of chromosomes is donated from each parent.

[Gametes](https://www.thoughtco.com/gametes-373465) - reproductive cells (eggs and sperm) that unite during sexual reproduction to form a new cell called a zygote.

[Gene Theory](https://www.thoughtco.com/gene-theory-373466) - one of the five basic principles of biology. It states that traits are inherited through gene transmission.

[Genes](https://www.thoughtco.com/genes-373456) - segments of [DNA](https://www.thoughtco.com/dna-373454) located on chromosomes that exist in alternative forms called [alleles](https://www.thoughtco.com/allele-a-genetics-definition-373460).

[Haploid Cell](https://www.thoughtco.com/haploid-cell-373467) - a cell that contains one complete set of chromosomes.

[Interphase](https://www.thoughtco.com/stages-of-mitosis-373534) - stage in the cell cycle where a cell doubles in size and synthesizes DNA in preparation for cell division. Consists of G1, S-Phase and G2.

[Meiosis](https://www.thoughtco.com/stages-of-meiosis-373512) - a two-part cell division process in organisms that sexually reproduce. Meiosis results in gametes with one-half the number of chromosomes of the parent cell.

[Metaphase](https://www.thoughtco.com/stages-of-mitosis-373534) - stage in cell division where chromosomes align along the metaphase plate in the center of the cell.

[Microtubules](https://www.thoughtco.com/microtubules-373545) – protein filaments that make up part of the cytoskeleton and part of the mitotic spindle.

[Mitosis](https://www.thoughtco.com/mitosis-study-guide-373530) - [a phase of the cell cycle](https://www.thoughtco.com/understanding-the-cell-cycle-373391) that involves the separation of nuclear chromosomes followed by cytokinesis.

[Nucleus](https://www.thoughtco.com/the-cell-nucleus-373362) - a membrane-bound structure that contains the cell's hereditary information and controls the cell's growth and reproduction.

[Prophase](https://www.thoughtco.com/mitosis-study-guide-373530) - stage in cell division where chromatin condenses into discrete chromosomes.

[Sister Chromatids](https://www.thoughtco.com/sister-chromatids-373547) - two identical copies of a single chromosome that are connected by a centromere.

[Spindle Fibers](https://www.thoughtco.com/spindle-fibers-373548) - aggregates of microtubules that move [chromosomes](https://www.thoughtco.com/how-chromosomes-determine-sex-373288)during cell division.

[Telophase](https://www.thoughtco.com/mitosis-study-guide-373530) - stage in cell division when the [nucleus](https://www.thoughtco.com/the-cell-nucleus-373362) of one cell is divided equally into two nuclei.

# Genetics

## VOCABULARY

### Heredity- the passing of traits from parent to offspring

### Nucleus- The control center of eukaryotic cells responsible for containing DNA

### DNA-Deoxyribonucleic acid. Carries instructions that determine traits of an organism

### Genes- unit of heredity which determines the traits you receive

### Alleles- the letters that represent the traits

### Meiosis- the process of cell division that makes sex cells (sperm and egg). Cells made from meiosis are haploid or half the number of chromosomes as diploid cells.

### Mitosis- the process of cell division that makes body/somatic cells. Each cell made is diploid and contains double the number of chromosomes as haploid cells. Each cell is an exact copy of the original.

### Dominant- The trait that overshadows or is seen. Represented by a capital letter.

### Recessive- The trait that hides in the background. Represented by a lowercase letter.

### Genotype- The letters that represent the trait – ex. RR, Rr, rr 11. Phenotype- The physical expression of the trait. Ex. Freckles, round, brown eyes.

### Heterozygous/Hybrid- Alleles that are different – will have one capital letter and 1 small letter Rf.

### Homozygous/Purebred- Alleles that are the same – will have either 2 capital letters symbolizing 2 dominant alleles for that trait or 2 lower-case letters symbolizing 2 recessive alleles for that trait.

### Clone - process of making an exact copy of an organism by copying the DNA of that organism and placing it into an egg cell which is stimulated to divide and create an organism.

### Adaptation = a new and beneficial trait. Adaptations increase the ability of an organism to survive in its environment and produce offspring. Adaptations (new beneficial traits) arise from spontaneous mutations. Creatures don’t choose to change!

### Allele = A factor or letter that makes up a gene.  2 alleles make up one gene.

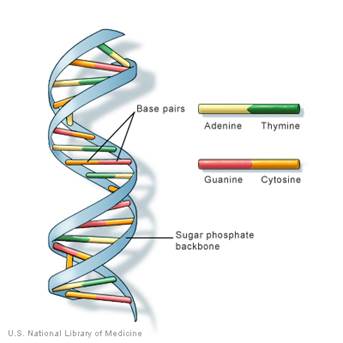
### Alleles = "B" and "b" are different alleles.

### Bases = Adenine, Thymine, Guanine and Cytosine. A matches with T and G matches with C. The sequence of bases make up your genetic code.

### Carrier = a person who has a recessive allele and a Dominant allele. In the case of Tay Sachs, a carrier would have this genotype: (Nn); the recessive allele is harmful. A brown-eye person who has a hybrid gene (Bb) can also be considered a carrier because the person carries the recessive allele for blue eye color, (b).

### Chromosomes = 46 are found in human cells. Genes are carried among chromosomes.

**DNA** = The main instructions that explain how to build the body. (Deoxyribose Nucleic Acid) DNA makes up alleles, genes and chromosomes.



**Dominance =**This is one of Johann Gregor Mendel’s principles. In his studies with pea plants Mendel notices that pure tall plants bred to pure short plants resulted in tall hybrid plants. Tallness was dominant to shortness.

**Dominant** = an allele that overpowers another is dominant. For instance, B overpowers and masks b. Brown eyes are dominant to blue eyes.

**Evolution** = any [process](http://en.wikipedia.org/wiki/Process) of change over time. Evolution is a change in the traits of living [organisms](http://en.wikipedia.org/wiki/Organism) over generations, including the emergence of new [species](http://en.wikipedia.org/wiki/Species). Since the development of modern [genetics](http://en.wikipedia.org/wiki/Genetics) in the [1940s](http://en.wikipedia.org/wiki/1940s), evolution has been defined more specifically as a change in the frequency of [alleles](http://en.wikipedia.org/wiki/Allele) in a population from one generation to the next. Evolution is change in the heritable traits of a population over many generations.

**Fit** = An organism that produces a large number of offspring is deemed **fit.** (Fitness has nothing to do with the size or strength of the critter-it is all about passing genes on. Frogs are fit. The Pope is not fit.)

**Gamete** = means sperm or egg. Germ Cell. In humans, a germ cell contains 23 chromosomes.

**Gene** = Every trait is controlled by a gene. A human has 20,000 genes. Genes are controlled by 2 factors called “alleles”. Each allele comes from a parent.

**Genotype** = All the genes of a beastie equal the genotype of the beastie. (Genes an organism possesses)

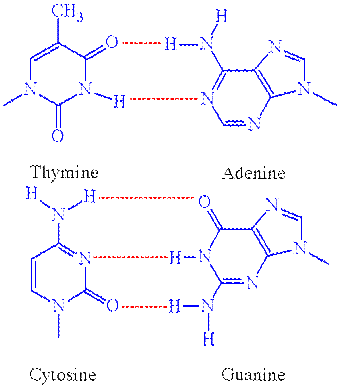
**Germ Cell**- An egg or sperm cell. A gamete. In humans, a germ cell contains 23 chromosomes.

**Heterozygous** = this means alleles of a gene are "different". See hybrid.

**Homozygous** = when alleles of a gene are "the same”. BB, nn, are all homozygous.

**Hybrid** = means alleles of a gene are "different" (Hh) See heterozygous.

**Hydrogen Bonds** = connect bases in the DNA molecule. The bond results between a positive hydrogen atom in one molecule and an electronegative atom in the other.



**Meiosis**= the kind of cell division that produces sperm and egg. Meiosis cuts the number of chromosomes in half. In humans, for instance, the nuclei of body cells contain 46 chromosomes. Due to meiosis, sex cells carry only 23 chromosomes – one chromosome from each original homologous pair.

**Mitosis** = the kind of cell division that splits an original cell into 2 identical daughter cells. Mitosis causes you to grow.

**Mutation** = A change in the DNA instructions. A change in the DNA sequence. The change can be beneficial, detrimental or neutral. It ultimately results in a change in protein. For instance, random genetic *mutation*gave rise to the dark phenotype of the peppered moth.

**Natural Selection** = Darwin said that the process that eliminates creatures with inferior traits and preserves those with superior traits is known as *natural selection.*  Critters with good traits will be selected by nature to survive. Those organisms that survive are more likely to produce offspring with the same advantages for survival thus increasing the population of the organism. Critters with negative traits will die off.

**Nucleotide** = One of the four DNA chemical submits: (A + sugar and phosphate), (T + sugar and phosphate), (G + sugar and phosphate), (C + sugar and phosphate). 3 billion nucleotides make up a human's genetic code.

**Phenotype** = the way an organism looks. The appearance.

**Recessive** = A small, weaker allele is recessive.

**Sex chromosomes** = the 23rd chromosome in humans chromosomes that determine sex (XY male and XX female)

**Somatic Cell** = Body cell that contains 46 chromosomes in humans.NON SEX CELLS

**Sugar = Deoxyribose sugar.** Found in backbones of DNA helix. Attaches to bases (AT, GC). Alternates with phosphate in the backbones.

**Trait**= is a feature of an organism.

**Variation** = in any population of critters, some are different from the others. For instance, the *variation* within the peppered moth population allowed the species to survive under the changing environmental conditions. Variety! In a population, critters are different – due to mutations.

# Evolution

## Evolution is very much still happening today — and it's happening to us, right here, right now. Our genes constantly change over time thanks to the power of selection.

## Recent Evolution in Humans

### Case 1: Drinking milk as adults

#### Milk and dairy products like ice-cream yogurt, cheese and butter contains lactose.

#### Lactose is a sugar found in milk and milk-based (dairy) products.

#### Lactase is an enzyme that functions to breakdown (metabolize) lactose in the body.

#### All mammals (besides modern humans) stop producing lactase after weaning (when the offspring no longer drinks its mother's milk

#### This means that they would no longer be able to digest milk when they get older.

#### have discovered a mutation that first appeared on the plains of Hungary about 7,500 years ago, that allowed some humans to digest milk into adulthood.

#### The ability to digest protein-rich, calorie-dense, dairy products was a definite evolutionary advantage.

#### We still see evidence of this genetic change today, because as many as 75% of humans still have some level of lactose intolerance.

### Case 2 - Blue Eyes - a Mutation

#### New research shows that people with blue eyes have a single, common ancestor.

#### Scientists have tracked down a genetic mutation which took place 6,000-10,000 years ago and is the cause of the eye color of all blue-eyed people.

#### Originally, everyone had brown eyes,

#### There was a genetic mutation in the OCA2 gene that adds melanin (pigmentation) to our eyes, that essentially turned the gene off. This caused a decrease in the melanin of the eye, thus turning blue.

#### Green-eyed people have less melanin than brown eyes, but more that blue-eyes.

### Case 3 - Wisdom Teeth

#### 25 % of humans today are born without wisdom teeth.

#### A few thousand years ago, a mutation popped up that prevented wisdom teeth from growing at all.

#### stopped needing wisdom teeth after humans begin cooking food and developed agriculture thousands of years ago.

#### This switch to softer foods, decreased the size of our jaw muscles.

#### Cave men would wear out their molars and have room for the wisdom teeth to replace the.

#### Most people don’t have room for them.

## Natural Selection

### The genetically inherited trait that increases the survival of that species would persist through the process of evolution by NATURAL SELECTION.

### The genetic trait that evolves from this process increases the probability that the species will survive in that particular environment is called an ADAPTATION.

## The Peppered Moth Example of Natural Selection

### The evolution of the peppered moth is a classic example of evolution due to natural selection. These moths resided in London in the 1800's during the Industrial Revolution.

### At the beginning of the 1800's there were more light-colored Peppered Moths than dark-colored Peppered Moths.

#### These moths would rest upon trees with white bark.

#### The dark-colored moths were easier to spot against the light backdrop of the white tree bark and consequently were eaten more often by hungry predatory birds.

#### The light-colored Peppered Moths camouflaged against the light-colored trees and were much more prevalent in the population. 95% of peppered moths were light at the start of the 1800s.

### By the end of the 1800's

#### the light-colored trees became dark due to the extensive pollution

#### Pollution from of coal burning was from the Industrial Revolution (soot deposits)

#### Dark trees caused the light-colored moths to be more visible to predators and, therefore, light colored moths were eaten quickly!

#### This caused a shift in the population of moths in which dark-colored moths became more common. 95% of Peppered Moths were dark-colored at the end of the 1800s. ​

## Blind Cave Fish - example of evolution and adaptation - use it or lose it

### The blind cave fish is so named because of its lack of eyes!

### They are blind

### They have NO EYES

### Hundreds of generations of fish ago, a fish, or group of fish, swam into the deep dark caves of Mexico.

### This could have been in search of food or to escape predators, or even both.

### The fish thrived in the new, dark environment and continued to live there in the darkness generation after generation.

### Over time, these fish stopped developing eyes.

### The energy that the fish would usually have had to spend creating the anatomy needed for sight, as well as for processing visual information, was now able to be reallocated to more useful functions.

### These fish also developed a type of sonar to assist their navigation in the dark, as well as other heightened senses.

# POPULATION ECOLOGY

## The world population was estimated to have reached ****7.5 billion**** in April, 2017. The United Nations estimates it will further increase to 11.2 billion in the year 2100.

## The Beginning…

### Homo sapiens evolved in Africa around 200.000 years ago.

### These modern humans evolved from the Homo erectus

### Homo erectus

#### walked upright

#### had good manual dexterity

#### used fire

## 50.000 years ago

### At this point in history, Homo sapiens ventured out of Africa and populated most of the world .

### The more modern traits we associate with modern humans evolved around 50.000 years ago.

### Advantages that explain the evolutionary success of modern humans include

#### Larger Brains

##### More developed neocortex, prefrontal cortex and temporal lobes. -

###### These brain areas are responsible for high-level thinking and advanced problem-solving skills.

#### Use of Tools

##### Modern humans used tools to a much greater degree than other animals.

#### Build and Use Fire

##### Modern humans are the only modern animal known to use fire.

###### Fire was used for warmth

###### Fire was used to cook food

#### Creativity

##### Modern humans have created complex languages, clothing, art, belief-systems and societies.

## Bubonic Plague (The Black Death

### Killed 50% of the European Population

### Killed ~ 1/5 of the total world population

### Occurred in the mid 1300’s

## How the World Changed after the Plague

### changes in hygiene and heath awareness, as well as social and economic changes.

## 1650 - World population was 0.5 Billion

### The discovery of germs as the cause of disease “germ theory”

### The invention of the microscope

### The increased knowledge of bacteria, viruses and the spread of disease changes the sanitation and hygienic practices of people in society.

## The World Population Hits 1 Billion in 1800

### Global life expectancy is only approximately 30 years, due to high child mortality rates.

### Public Health movement in 1843.

### Improvements in sanitation and awareness continued to combat diseases and increase the health and longevity of the human race.

## The World Population Hits 2 Billion People in 1927

## The World Population Hits 4 Billion People in 1974

## Today we are almost twice that, at 7.5 Billion People as of April 2017.

## **Population ecology** is a sub-field of **ecology** that deals with             1) the dynamics of species populations             2) how these populations interact with the environment             3) how the **population** sizes of species change over time and geographic location

## The human population is growing at an exponential rate and is affecting the environment and the populations of other species in return.

### Examples

#### chemical pollution

#### deforestation

#### irrigation

#### desertification (is a result of deforestation)

#### waste

#### resource depletion

## **Population density**

### Population Density is Analyzed by Looking at the Dispersion pattern of the population - The way individuals are spaced within an area

### There are 3 types of DISPERSION PATTERNS

##### Clumped dispersion – grouped in patches

###### most common type of dispersion

###### Is often the result of an unequal distribution of resources

###### Species that display a CLUMPED DISPERSAL PATTERN INCLUDE

Humans – clumped in urban areas

Sea stars – Clumped around Food Sources

Mushrooms – Clumped (grow) where rich soil is

##### Uniform dispersion pattern – evenly spread out over a given area

###### Is often the result individual interactions of a population, such as we see among humans when at a movie theater or a college lecture hall.

###### Uniform Distribution is Often the Result of Territorial behavior

##### Random dispersion pattern – spread out in an unpredictable way

###### Usually seen as the result of

Social Interactions

Varying Habitat Conditions

###### Examples of species that display a RANDOM DISPERSAL PATTERN

Dandelions

# **Survivorship Curves**

## There are 3 types of survivorship curves

### Type I

#### For a Species that exhibits a type I survivorship curve… Most of the individuals of that species will survive until they reach “old age”

#### Examples

###### Humans

###### Large Mammals

### Type II

#### For a Species that exhibits a type Ii survivorship curve – the survivorship of that species remains relatively constant over the lifespan.

#### Examples:

##### Hydra

##### Invertebrates

##### Lizards

##### Rodents

### Type III

#### For a Species that exhibits a type IIi survivorship curve – Most of the individuals of that species will die young.

#### Typically observed in animals who have large numbers of offspring, but provide little care for them

#### Examples

###### Fish

###### Oysters.

## **Models of Population Growth:**

### Exponential Growth (J-shaped)

#### Occurs when there are plenty of resources for the population

### Logistic (s-shaped)

#### Occurs when the size of the population begins to hit the carrying capacity of the environment – the limit of how many individuals of a population the environment can provide for.

## Carrying capacity (**K**) (the limitations of that environment)

### Limiting factors that contribute to the logistical growth model are …

#### Predation

#### Parasites

#### Food sources

#### Illness

#### Change in environment

#### Predation

#### Territory

#### Illness

#### Change in environment