

2. Inheritance and Probability

:Inheritance

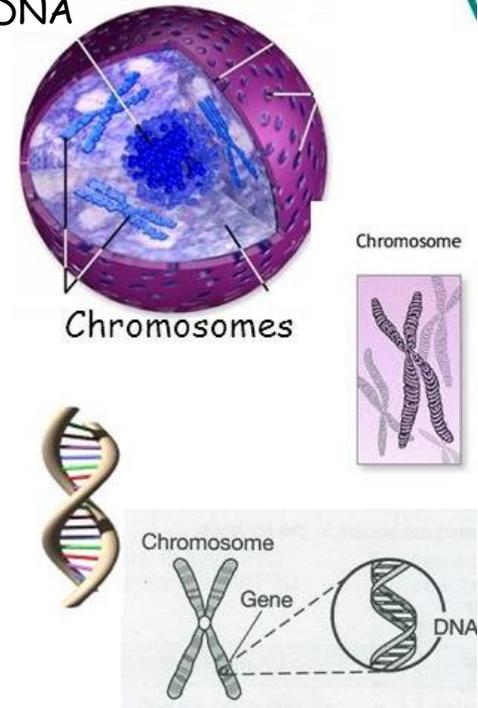
- heredity is controlled by chromosomes composed of DNA
- the instructions for each trait are found in sections of chromosomes called **genes** which are arranged in a **specific order** on each chromosome
- different genes control different **traits** and different chromosomes are made up of different genes
- each trait is controlled by at least 2 forms of a gene called an **allele**
- kinds of characteristics inherited

a) Species Characteristics

= traits specific to **a group of organisms**
ie. Humans always have opposable thumbs

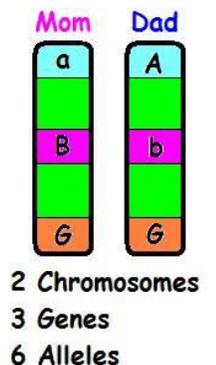
b) Individual Characteristics

- = traits making an individual in a species unique
- in complex organisms an offspring is always different from its parents because it is a **combination** of the parents
ie. A child has mother's hair color and father's nose
- for each trait one allele is inherited from the **father**, and one comes from the **mother**
= offspring can inherit different combinations of alleles from parents
- for each trait offspring can inherit:
 - 2 dominant alleles**
 - 2 recessive alleles**
 - 1 dominant and 1 recessive allele**



:Probability = **chance** that an event will occur

- even though we inherit from our parents, our environment will affect the **full potential** of what we inherited
Ie. Sunlight - lightens hair and darkens freckles
- in genetics, we work with a strict **mathematical probability**, we do not consider items like the environment, or other factors
- NEVER consider things you have seen on television, or personal experiences when you answer genetics questions, use only probability mathematics.



3. Mendel's Laws of Heredity

Gregor Mendel = Father of the science of genetics

- Austrian monk who studied garden peas and their traits
- Looked at peas because he observed that:
 - a) peas have a number of traits that are expressed in 1 of 2 ways
 - b) peas are both self-fertilizing and cross-fertilizing
- This allowed Mendel to look at single characteristics at a time and also to look at several generations of offspring to trace heredity
- He applied probability math to all his data formulating his laws

Mendel's Laws

A. The Law of Dominance

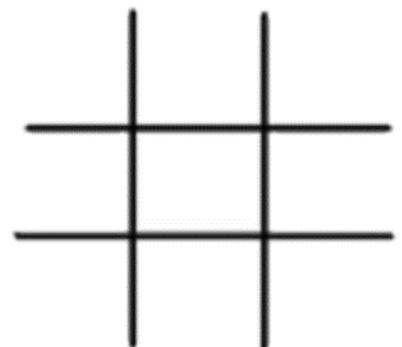
- When two different "factors" (alleles) control a trait:
 - the effect of one allele masks the effect of the other allele
 - :the expressed allele is known as dominant
 - :the masked allele is called recessive
- Mendel proved this by crossing plants with round seeds with plants having wrinkled seeds
 - All the offspring always had round seeds
 - = round is dominant and wrinkled is recessive
- Mendel's cross can be illustrated using a Punnett Square
 - = diagram which shows the probability of the offspring inheriting certain alleles from a cross between two different individuals
- In Mendel's experiment the parents were pure for their traits:

Round = RR wrinkled = rr

= homozygous

Monohybrid cross (1 trait is crossed)

P₁ = RR x rr



Results = F₁ (First Filial Generation)

a) **Phenotype** (how trait is expressed or what you see)

= 100% round

b) **Genotype** (genetically or which alleles are possessed for a trait)

= 100% Heterozygous round (two different alleles)

= Hybrid (Rr)

B. The Law of Segregation

- Chromosomes are arranged in **homologous pairs**
- Since a pair of genes control each trait in a diploid (2n) organism, when gametes are formed, a homologous pair is **separated** so that each gamete gets only **one** of the 2 alleles for the trait
 - Mendel proved this by crossing the plants from the F₁ generation

Illustration of Cross Using Punnett Square

Parents: Heterozygous round seeds (hybrids): Rr

F₁ = Rr x Rr

Results = F₂ (Second Filial Generation)

a) Phenotype: 75% round

25% wrinkled

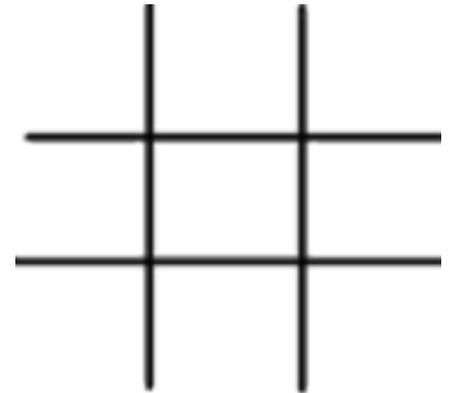
Ratio = 3:1 (probability)

b) Genotype: 25% (RR) homozygous dominant round

50% (Rr) heterozygous round

25% (rr) homozygous recessive wrinkled

Ratio: 1:2:1



<https://www.youtube.com/watch?v=0vAAf4g5iF8>

General Steps to Making a Punnett Square

- 1) Determine parents genotype - ex. AA or Aa or aa
- 2) Determine the possible gametes for each parent (sort alleles)
Ex. A parent who is AA can pass on only one type of allele: **A**
A parent who is Aa can pass on two types: **A or a**
- 3) Place the gametes from one parent vertically (across the top) and those from the other parent horizontally (along the side) of the square
- 4) Combine the traits together for each square. This represents the possible genotypes of each of the offspring
- 5) Interpret genotypes & phenotypes as required to determine the chance of one offspring inheriting any given genotype or phenotype (use %'s & ratios)

2. Inheritance and Probability

:Inheritance

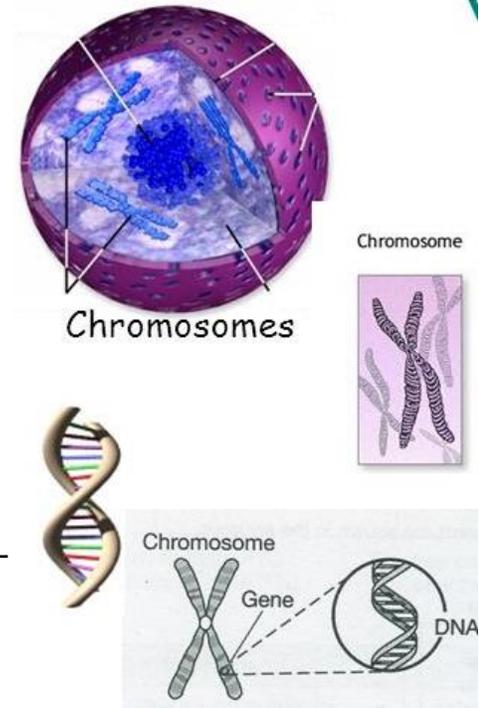
- heredity is controlled by chromosomes composed of DNA
- the instructions for each trait are found in sections of chromosomes called _____ which are arranged in a _____ on each chromosome
- different genes control different _____ and different chromosomes are made up of different genes
- each trait is controlled by at least 2 forms of a gene called an _____
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a) Species Characteristics

= traits specific to _____
ie. Humans always have opposable thumbs

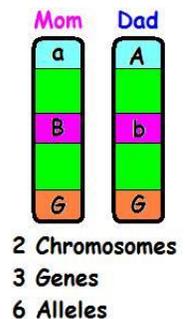
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- = traits making an individual in a species unique
- in complex organisms an offspring is always different from its parents because it is a _____ of the parents
ie. A child has mother's hair color and father's nose
- for each trait one allele is inherited from the _____, and one comes from the _____
= offspring can inherit different combinations of alleles from parents
- for each trait offspring can inherit:
 - 2 dominant alleles
 - 2 recessive alleles
 - 1 dominant and 1 recessive allele



:Probability = _____ that an event will occur

- even though we inherit from our parents, our environment will affect the _____ of what we inherited
Ie. Sunlight - lightens hair and darkens freckles
- in genetics, we work with a strict _____, we do not consider items like the environment, or other factors
- NEVER consider things you have seen on television, or personal experiences when you answer genetics questions, use only probability mathematics



3. Mendel's Laws of Heredity

Gregor Mendel = Father of the science of genetics

- Austrian monk who studied garden peas and their traits
- Looked at peas because he observed that:
 - a) peas have a number of traits that are _____
 - b) peas are both _____
- This allowed Mendel to look at single characteristics at a time and also to look at several generations of offspring to trace heredity
- He applied probability math to all his data formulating his laws

Mendel's Laws

A. The Law of Dominance

- When two different "factors" (alleles) control a trait:
 - the effect of one allele _____ the effect of the other allele
 - :the expressed allele is known as _____
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- Mendel proved this by crossing plants with round seeds with plants having wrinkled seeds
 - All the offspring always had round seeds
 - = round is _____ and _____ is recessive
- Mendel's cross can be illustrated using a _____
 - = diagram which shows the probability of the offspring inheriting certain alleles from a cross between two different individuals
- In Mendel's experiment the parents were pure for their traits:

Round = RR wrinkled = rr
= _____

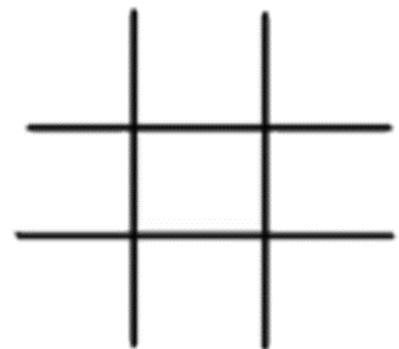
Monohybrid cross (1 trait is crossed)

P₁ = _____

Results = F₁ (First Filial Generation)

a) **Phenotype** (how trait is _____ or what you see)
= _____

b) **Genotype** (genetically or which _____ are possessed for a trait)
= 100% _____ round (two different alleles)
= **Hybrid** _____



B. The Law of Segregation

- Chromosomes are arranged in _____
- Since a pair of genes control each trait in a diploid ($2n$) organism, when gametes are formed, a homologous pair is _____ so that each gamete gets only _____ of the 2 alleles for the trait
 - Mendel proved this by crossing the plants from the F_1 generation

Illustration of Cross Using Punnett Square

Parents: Heterozygous round seeds (hybrids): Rr

F_1 = _____

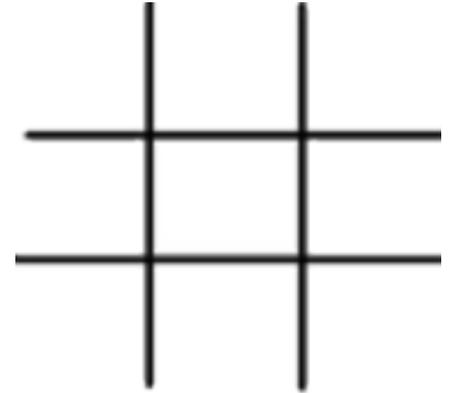
Results = F_2 (Second Filial Generation)

a) Phenotype: _____ round
_____ wrinkled

Ratio = _____ (probability)

b) Genotype: 25% (RR) _____
50% (Rr) _____
25% (rr) _____

Ratio: _____



<https://www.youtube.com/watch?v=OvAAf4g5iF8>

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UNIT 3: GENETICS

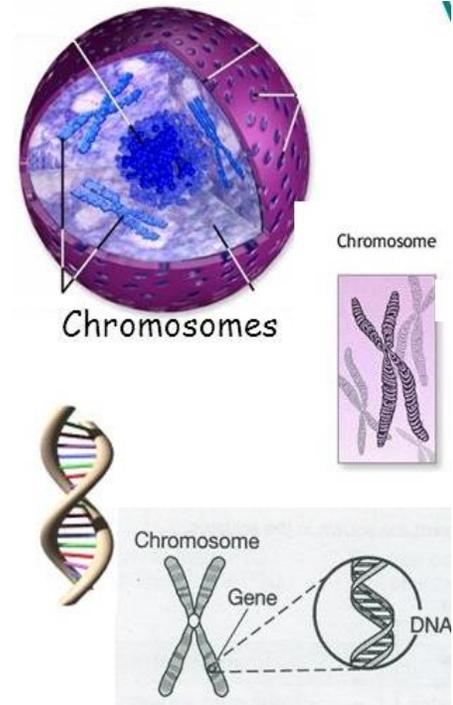
1. Inheritance and Reproduction

Genetics - study of the _____ of biological traits

Heredity- the passing of traits from _____

= Inheritance

- heredity is controlled by a _____ in our DNA
- this genetic code is located in _____
 - :are sections of chromosomes
 - :are arranged in a _____ on each chromosome
- different genes control different _____ and different chromosomes are made up of different genes
- each trait is controlled by at least 2 forms of a gene called an _____
- passing of traits occurs via the process of _____



Reproduction Review

- all living things reproduce in order to _____

- Two Types Of Reproduction:

A) Asexual Reproduction

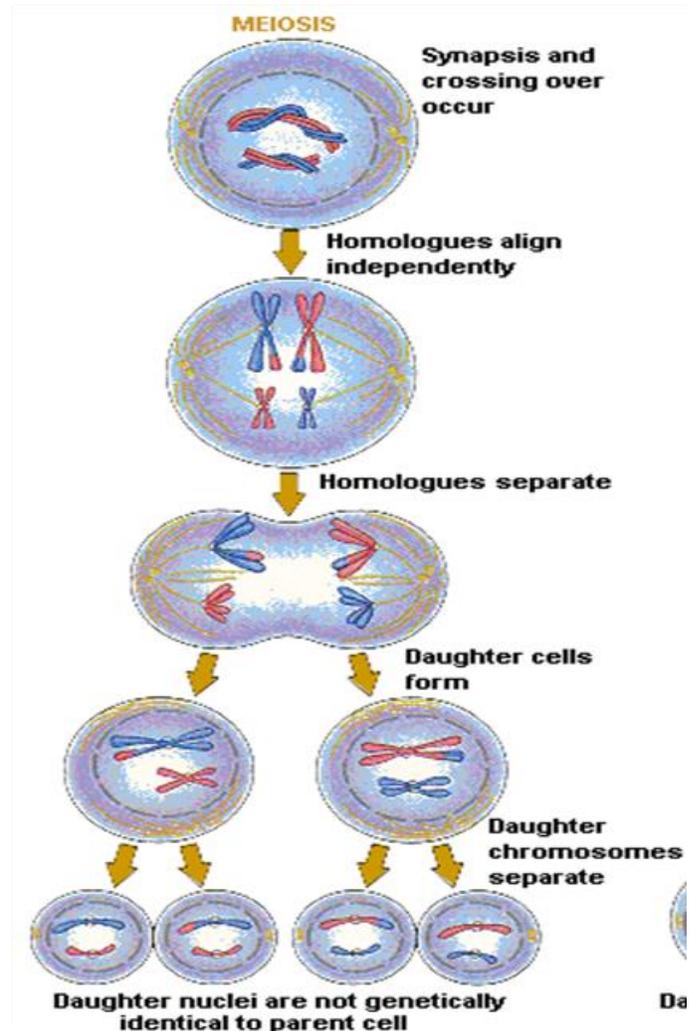
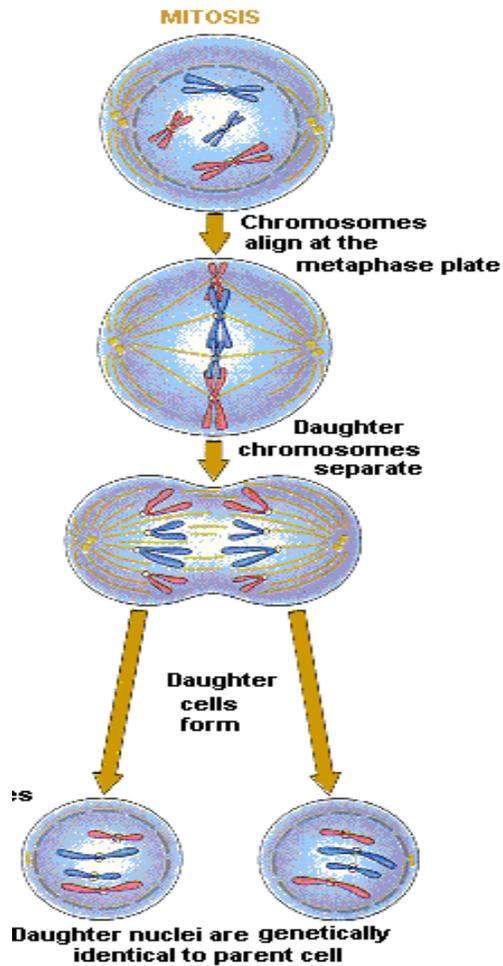
- Offspring are produced from only _____
 - Offspring are then _____ to the parent (clones)
- = _____ - daughter cell is identical to parent cell
- Seen in: Simple organisms like bacteria = offspring
Multicellular organisms = growth and repair

B) Sexual Reproduction

- Offspring are produced from _____
- Each parent donates one special sex cell called a _____
- Each gamete contains only _____ of the full number of chromosomes for that organism = _____
Ex. Humans: $n =$ _____
- Two gametes will fuse in a process called _____ producing a zygote with the full chromosome number _____
Ex. Humans: $2n =$ _____
- This assures genetic _____ within the species
 - = offspring are never identical to one parent as each parent passes only 1 allele for each trait (like shuffling cards before dealing)
- Gametes are produced through a type of cell division called _____

Meiosis (Reduction Division)

- Type of cell division occurring in _____
- Gametes contain only _____ the number of chromosomes as the parent cell therefore, division must occur _____



<https://www.youtube.com/watch?v=xORFVyD6qDw>

	Mitosis	Meiosis
Type of cell in which it occurs		
Number of Cells produced		
Number of chromosomes in the parent cell		
Number of chromosomes in the daughter cells		
Type of cell produced		
Function of process		

Environmental Factors

- even though we inherit from our parents, our environment will affect the _____ of what we inherited
Ie. Sunlight - lightens hair and darkens freckles
- in genetics, we work with a strict _____ we do not consider items like the environment, or other factors
- NEVER consider things you have seen on television, or personal experiences when you answer genetics questions, use only probability mathematics.
- Probability: _____

2. Probability Genetics: Mendel's Laws of Heredity

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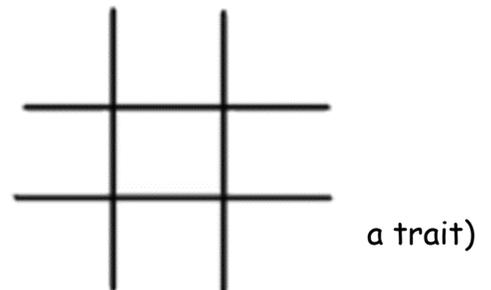
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Parents: Heterozygous round seeds (hybrids): Rr

F_1 = _____

Results = F_2 (Second Filial Generation)

a) Phenotype: _____ round
 _____ wrinkled

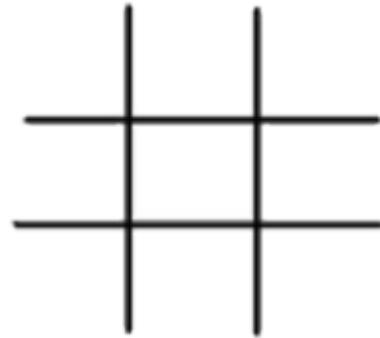
Ratio = _____ (probability)

b) Genotype: 25% (RR) _____

50% (Rr) _____

25% (rr) _____

Ratio: _____



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Stages of Meiosis

A) Meiosis I

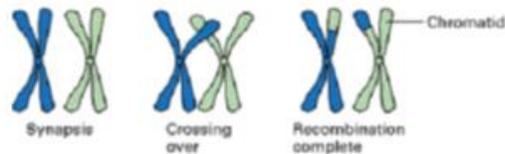
- consists of phases similar to Mitosis
- Chromosomes have replicated during interphase and are double stranded
- During Prophase I, each chromosome pair up with another chromosome that is similar in size and shape to form tetrads via a process called synapsis.

:A tetrad contains four sister chromatids = **homologous pair**

- As the homologous chromosomes move closer together, they intertwine

move

and can break and exchange information



genetic

- This is called crossing-over

- During anaphase I: the centromeres do not come apart
= one double stranded chromosome moves to each pole via segregation

Result of Meiosis I:

- 2 haploid (n) daughter cells, each has $\frac{1}{2}$ the # of chromosomes as the parent cells
- = The number of chromosomes is reduced by half

B. Interkinesis = resting stage between Meiosis I and Meiosis II
= NO REPLICATION of chromosomes

C. Meiosis II

- Occurs at the same time in each haploid daughter cell
- is basically a Mitotic division of each daughter cell, except the spindles are formed perpendicular to those in meiosis I

Result of Meiosis II:

- 4 haploid daughter cells which are called GAMETES

