GENETICS UNIT NOTES

Topic 1: Cracking the Mystery of Heredity

The details of heredity remained a _____ for many years

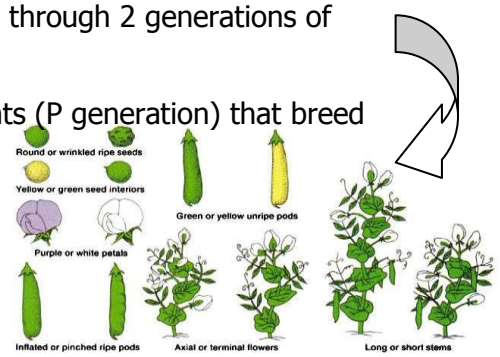
Many thought the parents' traits _____ in the next generation … much like mixing red and white paint to get pink

The first person to begin solving the mystery of heredity in the 1800s was an Austrian monk named _____

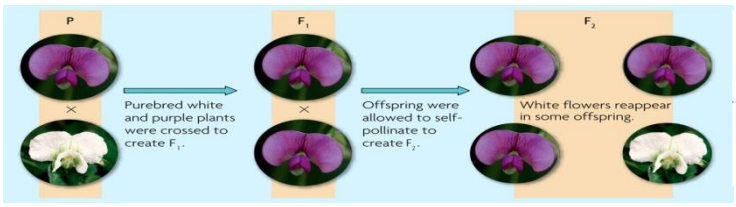
Mendel's Experiments

- Mendel's understanding of heredity came from several years observing how traits are inherited in _____
- He chose to follow 7 simple traits that occur in 2 _____ forms through 2 generations of breeding experiments.
- Mendel's experiments began by _____cross- pollinating parent plants (P generation) that breed _____generation after generation for 2 opposite forms of a trait

  (e.g. _____flowers x _____flowers)

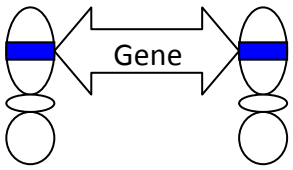


- The next generation (F_1) had all _____ flowers
- Mendel wondered what had happened to the white trait???
- He allowed the purple flowered F_1 generation to _____-pollinate the next generation to see what would happen?
- The second generation (F_2) had many purple flowers but some _____ flowers…..HOW???
- Mendel suggested that each pea plant trait is determined by inheriting ____ gene codes, one from each parent
- Mendel was the first to crack this inheritance mystery when he proposed that one gene code is _____ and the other gene code is _____ and remains "hidden" unless both genes are recessive
- Mendel repeated his experiment for other traits and noticed _____in the first and second generations of his crosses.
- Mendel wondered why the recessive trait consistently seemed to _____during the F_1 generation but then reappeared in the F_2 generation only _____ of the time???
- He reasoned that this consistent **3:1** ratio in the traits follows the rules of math _____. This means that each time a parent creates a gamete, they must randomly send only 1 of their 2 gene codes just like _____. Today we understand why Mendel's "coin toss" idea was correct because we can see the two genes move in opposite directions during Anaphase 1 of _____.



- Mendel's legacy is that his work laid the _____for understanding heredity
- His ideas about heredity correctly explain how many traits are inherited, not only for pea plants, but also for all sexually reproducing organisms from insects to _____.

Topic 2: Inheritance TERMS



Gene: a segment of DNA or a chromosome "_____" with coded information for a particular trait or characteristic. Because animals are _____ (i.e., chromosomes in homologous pairs), there are 2 gene"Mailboxes" for each trait…one inherited from each _____.

Allele: Actual DNA "_____" or N-base codes found in the gene "Mailbox". One allele is inherited from each parent for each genetic _____.

Ex: Gene = repair enzyme; Alleles = broken vs normal

Gene Notation: letters are used to represent _____. Rule: ___ letter for each trait

Dominant: alleles which hide / mask the information carried by _____ alleles. Notation = _____ letters

Ex: _____ = normal repair enzyme allele

Recessive: alleles which are only expressed or observed when _____ paired with a Dominant allele (i.e., need _____recessive alleles to observe the trait) Notation = lowercase letters

Ex: ____ = broken repair enzyme allele

Genotype: the ____ alleles inherited for each genetic trait →the actual genetic info.

Homozygous: 2 copies of the _____ allele for a trait. Ex: ____ or _____

Heterozygous: 2 _____ alleles for a trait Ex: _____

Phenotype: physical appearance of the expressed trait which can be seen.
Ex: have the _____ or are normal and symptom free. (i.e., sick or healthy)

Pedigree: a family _____ picture showing how a certain trait is inherited over several _____

Punnett square: a box like diagram used to predict the _____ of expected outcomes for a genetic cross

Punnett square Quick Tips:

- Define your Dominant & Recessive letter symbols: make a key or legend
- Write each Parent _____
- Fill in Mom's egg and Dad's sperm _____ along the PS sides
- Complete the PS boxes to see all the possible genetic cross outcomes or kids _____

Topic 3: ONE-Trait Crosses

Example 1: What is the chance that a child will have freckles if **DAD** is homozygous for freckles and **MOM** does not have freckles? _____

Gene Notation ____ = _____

Symbols Used: ____ = _____

Parent MOM = _____

Genotypes: DAD = _____

Dad's Sperm varieties

Mom's Egg Varieties

Example 2: What is the chance that a child will have a straight hairline if **DAD** is heterozygous for widow's peak and **MOM** has a straight hairline? _____

Gene Notation ____ = _____

Symbols Used: ____ = _____

Parent MOM = _____

Genotypes: DAD = _____

Dad's Sperm varieties

Mom's Egg Varieties

Example 3: XP disorder is caused by a **recessive** mutation. What is the chance that a couple will have a child affected with XP if MOM is a heterozygous carrier and DAD has XP? _____

Gene Notation ____ = _____

Symbols Used: ____ = _____

Parent MOM = _____

Genotypes: DAD = _____

Dad's Sperm varieties

Mom's Egg Varieties

Example 4: Huntington's Disease (HD) is caused by a **Dominant** mutation. What is the chance that a couple will have a child affected with HD if MOM is heterozygous for HD and DAD is homozygous normal and disease free? _____

Gene Notation ____ = _____

Symbols Used: ____ = _____

Parent MOM = _____

Genotypes: DAD = _____

Dad's Sperm varieties

Mom's Egg Varieties

Example 5 Dwarfism(HD) is caused by a **Dominant** mutation. What is the chance that a couple who are both dwarfs will have a child with NORMAL height if MOM and DAD are heterozygous for dwarfism? _____

Gene Notation ____ = _____

Symbols Used: ____ = _____

Parent MOM = _____

Genotypes: DAD = _____

Dad's Sperm varieties

Mom's Egg Varieties

LET'S REVIEW: Genetic diseases usually happen in 1 of 2 ways:

1) A person inherits 1 or more _____ DNA codes => _____ proteins inside cells that don't work correctly

Examples?

Remember:

A) If the mutation is Dominant => any person who inherits at least _____ mutation will show the disease

B) If the mutation is Recessive => only people who inherit _____mutations will show the disease

C) If the mutation is Recessive => people who inherit only _____ mutation will be healthy _____who could pass the mutation to their kids

2) A person inherits the wrong _____ of chromosomes => _____ during development

Examples?

Topic 4: Two-Trait Crosses

What are the 4 possible gamete types that are created in equal amounts during Meiosis for the genotype ***RrYy*** *?*

Hint: time to FOIL → **1) _____ 2) _____ 3) _____ 4) _____**

The principle of independent assortment is revealed by tracking _____ characteristics at once

Mom's genotype: BbRr (Black fur & running mouse)

possible egg varieties:

Dad's genotype: BbRr (Black fur & running mouse)

possible sperm varieties:

Phenotype Probabilities:

Black fur, Running: ____/16

Black fur, waltzing: ____/16

Brown fur, Running: ____/16

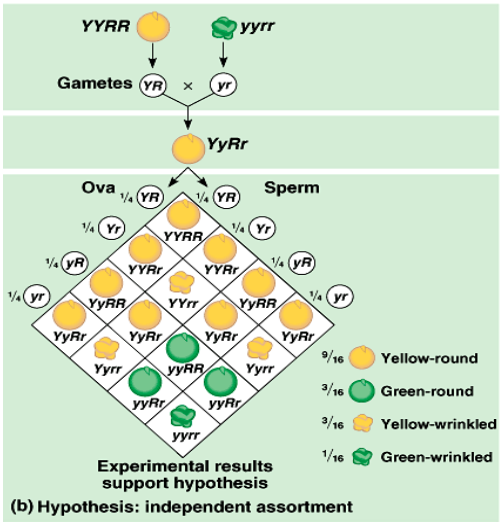
Brown fur, waltzing: ____/16

When Mendel studied controlled crosses for _____ over 2 generations he discovered consistent F_2 phenotype fractions:

- Show both dominant traits ___/16
- Show 1 dominant & 1 recessive ___/16
- Show other dominant & recessive ___/16
- Show both recessive traits ___/16

- WHY? …. Mendel again concluded that the **rules of math probability** will explain these F_2 phenotype fractions only if the alleles for 1 trait segregate independently of the other trait's allele pairs during Meiosis gamete formation

- This is known as the _____



- Basically, for any 2 traits that you might pay attention to as you go through Meiosis to make a gamete, the 2 chromosomes carrying those alleles can line up in different ways during _____ and that means that the gamete produced might have both alleles from your DAD, both alleles from your MOM, or 1 allele from MOM and 1 allele from DAD.

Review: Mendel's laws of heredity

- **Law of segregation**
  - Applies to inheritance of _____
  - Answers the question: _____?
  - each allele segregates (goes a different direction during _____) into separate gametes
- **Law of independent assortment**
  - Applies to inheritance of _____
  - genes on _____ assort into gametes independently
  - Happens because of the random arrangement of chromosome pairs during _____ (Mom..Mom..Dad..Mom…etc, lineup is different each time)
  - **EXCEPTION**: won't work if the 2 traits are located as neighbors on the _____ = linked genes

Topic 5: Deeper Mysteries of Heredity

Some traits are determined by more than the simple interaction of dominant and recessive alleles

Incomplete Dominance happens when a trait is a _____ of the two alleles

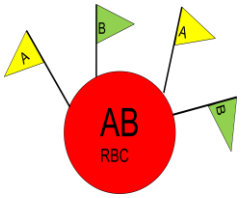
- Example 1: Crossing green and steel blue betta fish creates a blended_____ fish
- Another example of **Incomplete Dominance** happens with some flowers
- Example 2: Crossing red and white flowers creates a blended_____ flower

_____

****

Codominance is another more complex situation that happens when two alleles are _____ expressed together at the same time

- Example 1: Some people inherit an ___ blood allele from one parent and a ___ blood allele from the other parent and end up expressing both codes with ____ blood



Many genes have more than two alleles in the population = _____

- Human ABO blood types are determined by ____ alleles in the human gene pool:
- The alleles for A and B blood types are codominant, and have the following symbols: _____
- The O allele is recessive = _____
- If B blood people receive A blood during a transfusion, the anti-A antibodies will cause a _____

- List all the possible blood **genotypes** and **phenotypes** and their corresponding fractions for children conceived from a male heterozygous for type A blood with a woman with homozygous type B blood.

MOM = _____

DAD = _____

Genotypes	fractions	Phenotypes	fractions

(a) Phenotype (blood group)	(b) Genotypes (see p.258)	(c) Antibodies present in blood serum	(d) Results from adding red blood cells from groups below to serum from groups at left			
			A	B	AB	O
A	$I^A I^A$ or $I^A i$	Anti-B				
B	$I^B I^B$ or $I^B i$	Anti-A				
AB	$I^A I^B$	—				
O	ii	Anti-A Anti-B				

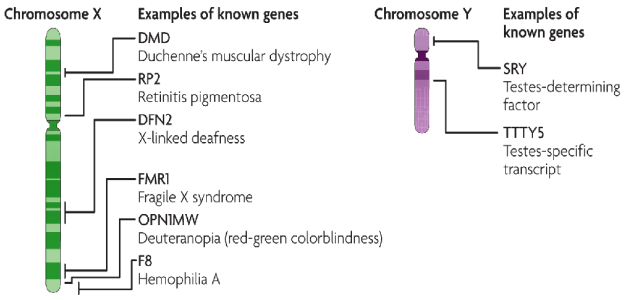
- Another example of **Codominance** happens with some horses and cows
- Example 2: Crossing black and white horses creates a _____ horse

A few traits are **SEX-LINKED**. This means the gene for the trait is located on the ___ chromosome

If females are _____ and males are _____, how do you think recessive disease mutations affect girls vs boys ???

Sex-linked genes affect males and females in _____ways:

- **Color blindness** is a sex-linked trait caused by a recessive mutation (**b**= colorblind allele)
- Males → _____show the sex-linked trait if inherited (_____)
- Females → _____show CB, only when **homozygous** (_____)
  - → Most females are _____but could be:
    - **Heterozygous** _____(_____)
    - **Homozygous** (_____)
- Sex-linked disorders affect mostly _____
- Females are often healthy _____
- Most sex-linked human disorders are due to _____alleles
  - Examples: _____, _____, _____



- A male receives a single X-linked allele from his _____, and will have the disorder, while a female has to receive the allele from _____to be affected
- Trait is NEVER passed from _____ to son

Let's try a **sex-linked** Punnett Square:

Jim is not colorblind and neither is his wife, Mary. However, because Mary's dad WAS colorblind, she is heterozygous for red-green colorblindness. Will any children be colorblind? _____

Gene Notation ____ = _____

Symbols Used: ____ = _____

Parent MOM = _____

Genotypes: DAD = _____

Dad's Sperm varieties

Mom's Egg Varieties

Topic 6: Pedigree Skills

1) Is the trait Dominant or Recessive?

- **Dominant** hints: common? 2 sick parents have a _____ kid?
- **Recessive** hints: rare? 2 healthy parents have a _____ kid = _____?

2) Write the **genotype** for each person

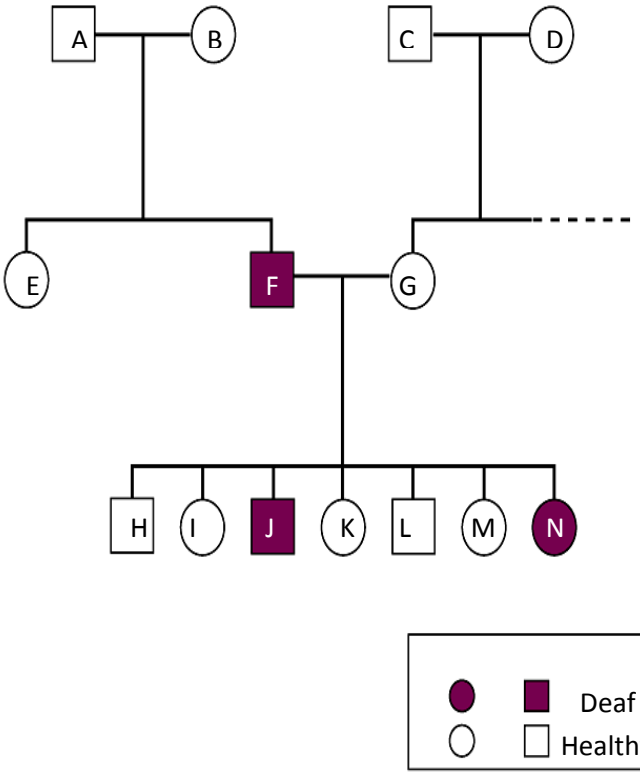
- HINT: always start with the ones who have 2 _____ alleles
- List all the persons who have a homozygous genotype? _____
- List all the persons who could have more than 1 possible genotype? _____

3) Determine the **Phenotype** for each person

- Person A = _____
- Person F = _____
- Person M = _____

4) Determine the **chance** for parents **A** & **B** to have a deaf child? _____

Pedigree for Human Deafness



Gene Notation ____ = _____

Symbols Used: ____ = _____

Parent MOM = _____

Genotypes: DAD = _____

Dad's Sperm varieties

Mom's Egg Varieties
