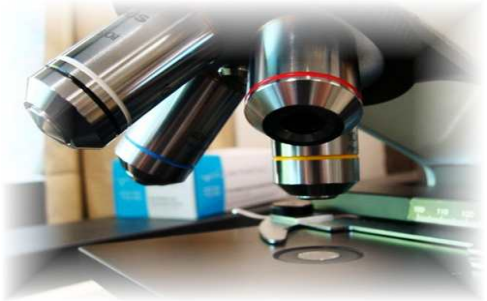

About Science Prof Online PowerPoint Resources

• Science Prof Online (SPO) is a free science education website that provides fully-developed Virtual Science Classrooms, science-related PowerPoints, articles and images. The site is designed to be a helpful resource for students, educators, and anyone interested in learning about science.

• The SPO Virtual Classrooms offer many educational resources, including practice test questions, review questions, lecture PowerPoints, video tutorials, sample assignments and course syllabi. New materials are continually being developed, so check back frequently, or follow us on Facebook (Science Prof Online) or Twitter (ScienceProfSPO) for updates.

• Many SPO PowerPoints are available in a variety of formats, such as fully editable PowerPoint files, as well as uneditable versions in smaller file sizes, such as PowerPoint Shows and Portable Document Format (.pdf), for ease of printing.

• Images used on this resource, and on the SPO website are, wherever possible, credited and linked to their source. Any words underlined and appearing in blue are links that can be clicked on for more information. PowerPoints must be viewed in *slide show mode* to use the hyperlinks directly.

• Several helpful links to fun and interactive learning tools are included throughout the PPT and on the Smart Links slide, near the end of each presentation. You must be in *slide show mode* to utilize hyperlinks and animations.

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Image: Compound microscope objectives, T. Port

"Pass the Peas like we use to say!"

Genetics:

Mendelian Inheritance & Heredity

Image: Sweet pea flower; Giligone; Gregor Mendel, Wiki

Genetics Terminology: Chromosomes & Genes

- **Genome** - Complete complement of an organism's DNA.
- Cellular DNA is organized in **chromosomes**.
- **Genes** have specific places on chromosomes.

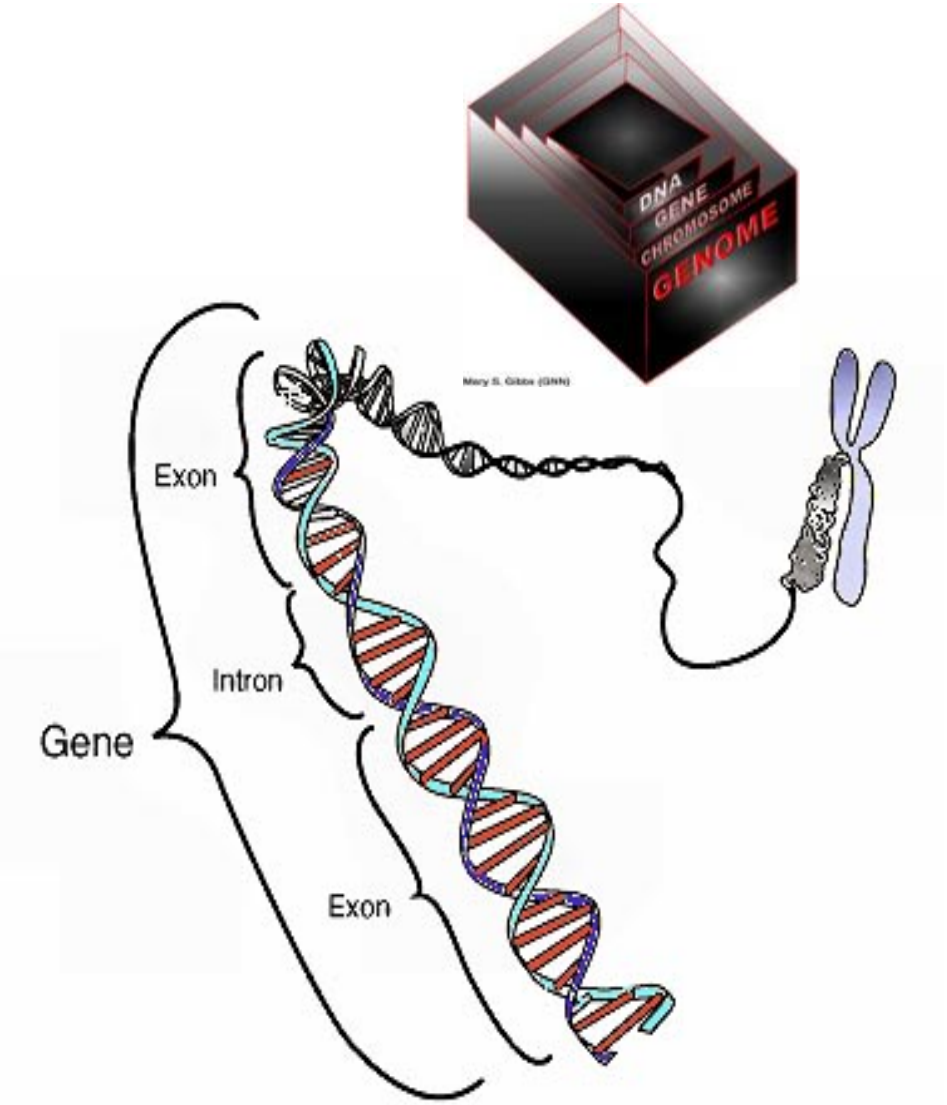


Image: Chromosome & gene, Graham Colm, National Human Genome Research Institute

So who was Mendel?

- Once upon a time (in the 1860's), there lived an Austrian monk named Gregor Mendel.
- Mendel spent his spare time breeding pea plants.
- He did this over & over & over again, and noticed patterns to the inheritance of traits, from one set of pea plants to the next.
- By carefully analyzing his pea plant numbers, he discovered three laws of inheritance.
- Mendel's Laws are as follows:
  1. **Law of Dominance**
  2. **Law of Segregation**
  3. **Law of Independent Assortment**
- *In his work, the words "chromosomes" or "genes" are nowhere to be found. The role of these things in relation to inheritance & heredity had not been discovered yet.*
- *What makes Mendel's contributions so impressive is that he described the basic patterns of inheritance before the mechanism for inheritance (namely genes) was even discovered!*

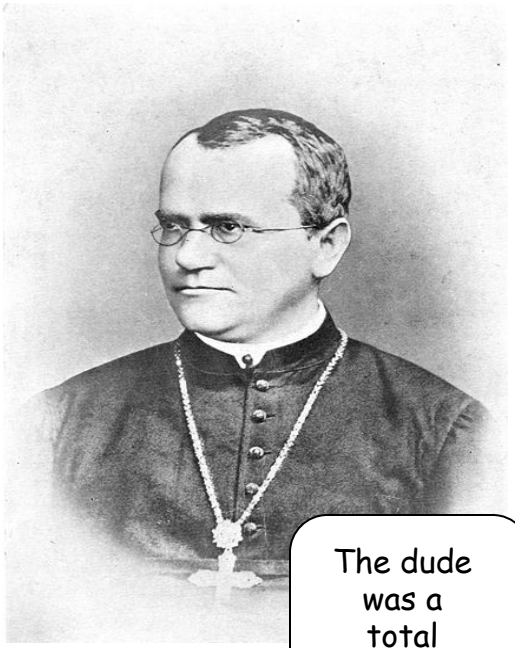


Image: Gregor Mendel, Mendel's Principles of Heredity: A Defense by Bateson, William; Spicoli from Fast Times at Ridgemont High

First, a little more genetics terminology.

Then…

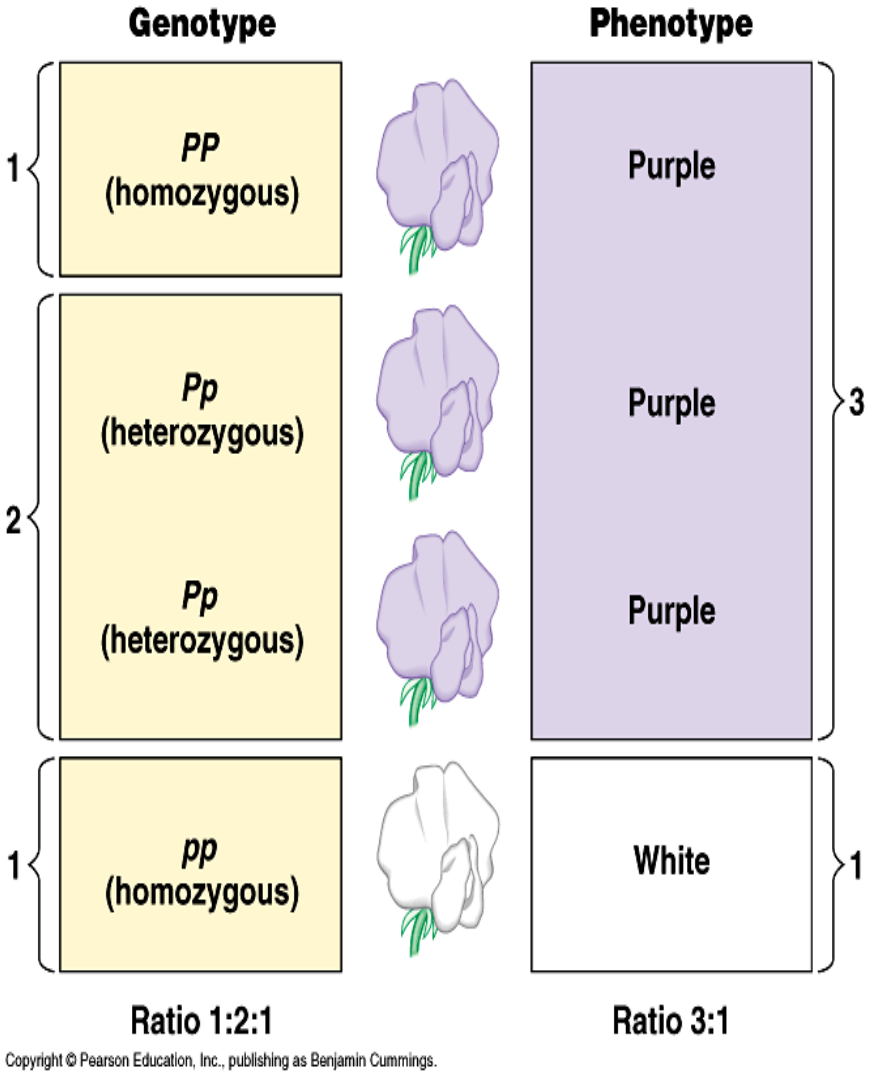
Mendel's Laws

1. Law of Dominance
2. Law of Segregation
3. Law of Independent Assortment

Image: Gregor Mendel, Mendel's Principles of Heredity: A Defense by Bateson, William.

Genetics Terminology

- **genotype**: the genes of an organism (*all your genes)*
- **phenotype**: an organism's traits *(expression of your genes)*
- **allele**: variations of a gene
- Represented with letters for the different types of **alleles** (PP, Pp, pp)
- **homozygous**: pair of identical alleles for a character (PP, pp)
- **heterozygous**: two different alleles for a gene (Pp)

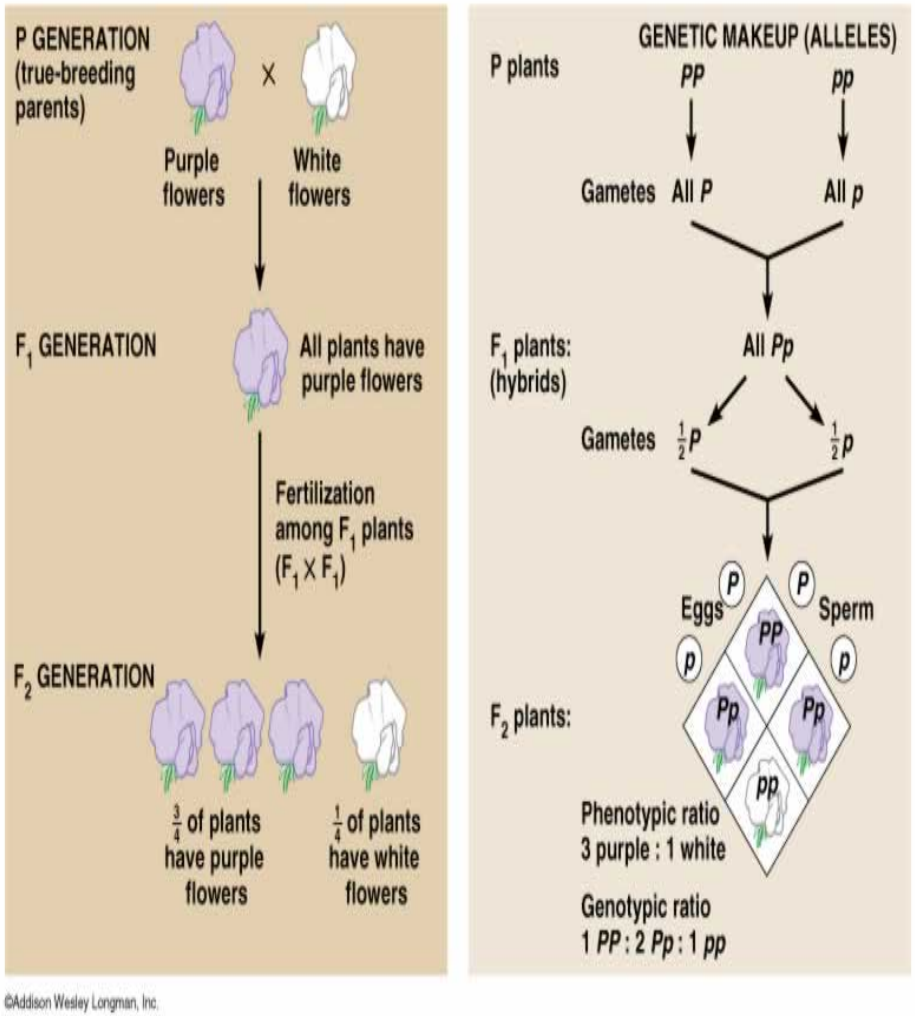


Genetics Terminology

- **Character:** heritable feature (i.e., fur color)
- **Trait:** variant for a character (i.e. brown)
- **True-bred:** all offspring of same variety
- **Hybridization:** crossing of 2 different true-breds

We label the different generations of a cross as:

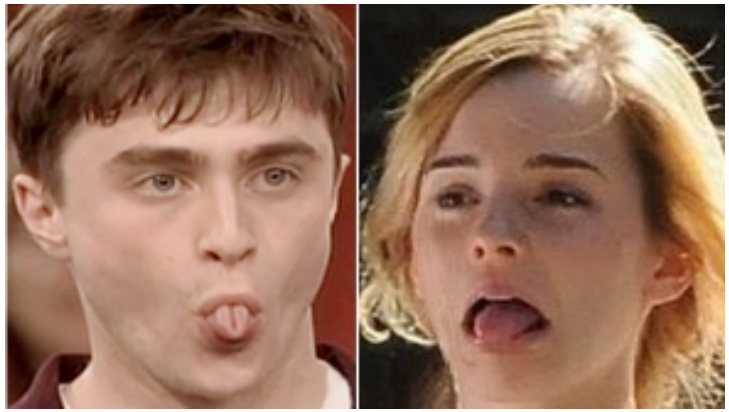
- **P generation** (parents)
- **F_1 generation** (1st filial generation)
- **F_2 generation** (2nd filial generation)



Genetics Terminology

Dominant & Recessive

Genotypes & Phenotypes



_____ **genotype:**

Both recessive alleles must be present (rr).

_____ **genotype:**

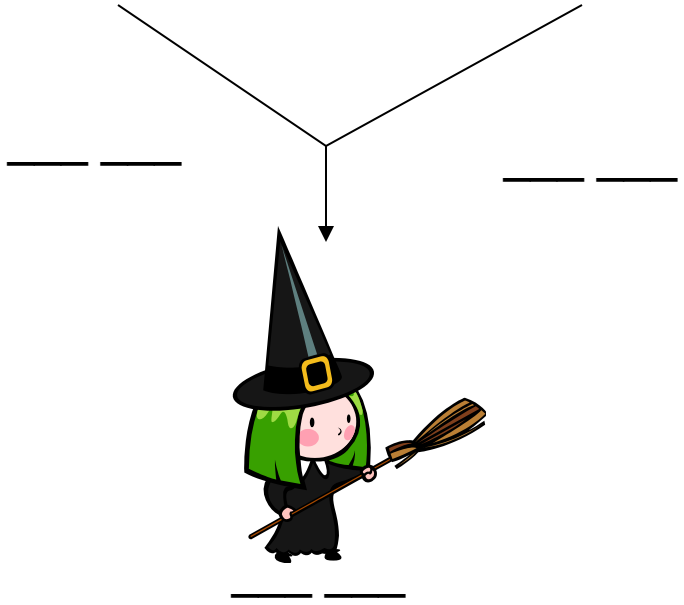
At least one dominant allele is present (R-).

Character: Tongue Rolling

Being able to **roll your tongue** is a dominant phenotype.

Harry: Being able to roll your tongue is the dominant trait (phenotype). ***Q:*** *How would we represent the genotype if he was* ***homozygous dominant****?*

Hermione: Not being able to roll your tongue is the recessive (phenotype). ***Q:*** *What would be the recessive genotype?*



Q: *Would "Harriet" be able to roll her tongue?*

1. Mendel's Law of Dominance

- In a cross of parents that are pure for contrasting traits, only one form of the trait will appear in the next generation.

- Offspring that are hybrid for a trait will have only the dominant trait in the phenotype.

Q: On last slide: *If Harry's was heterozygous, what are the possible genotypes for Harriet?*

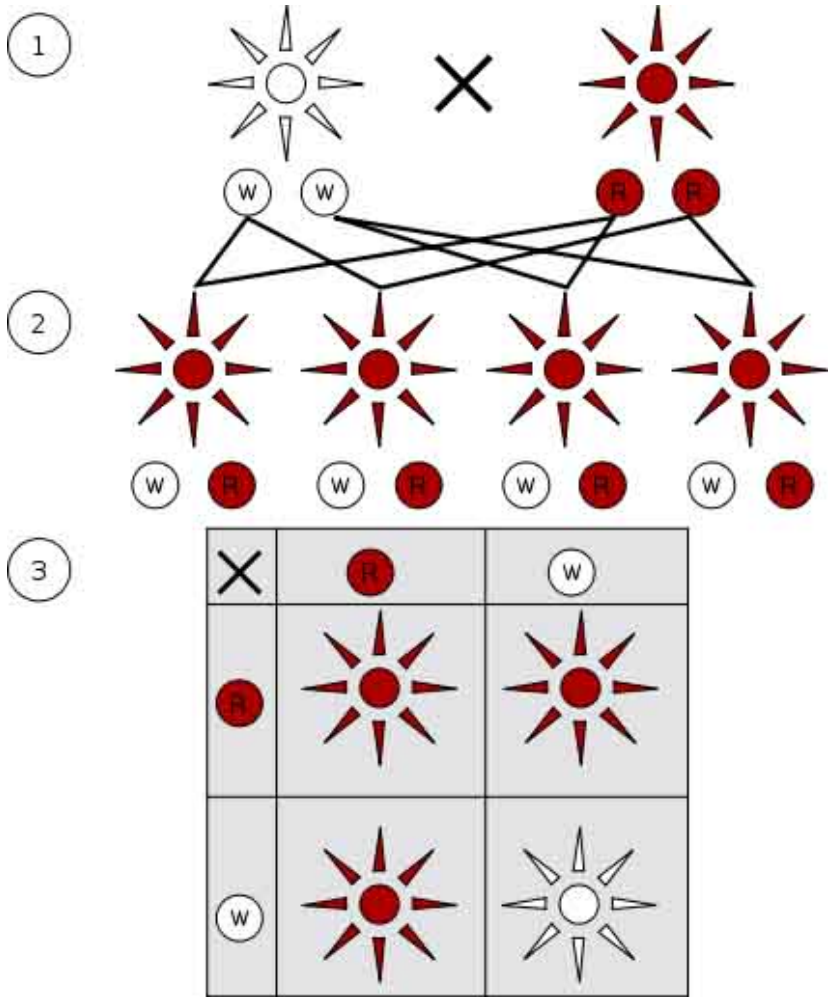


Image: Simple Inheritance, complete dominance, Magnus Manske

2. Mendel's Law of Segregation

- Alternative versions of genes (**alleles**) result in variations in inherited characteristics.
- For each character, an organism inherits 2 alleles (one from each parent).
- The alleles for each character segregate **(separate)** during gamete production. **Q**: What type of cell division produces gametes (sperm & eggs)?
- Alleles for a trait are recombined at fertilization, becoming genotype for the traits of the offspring.

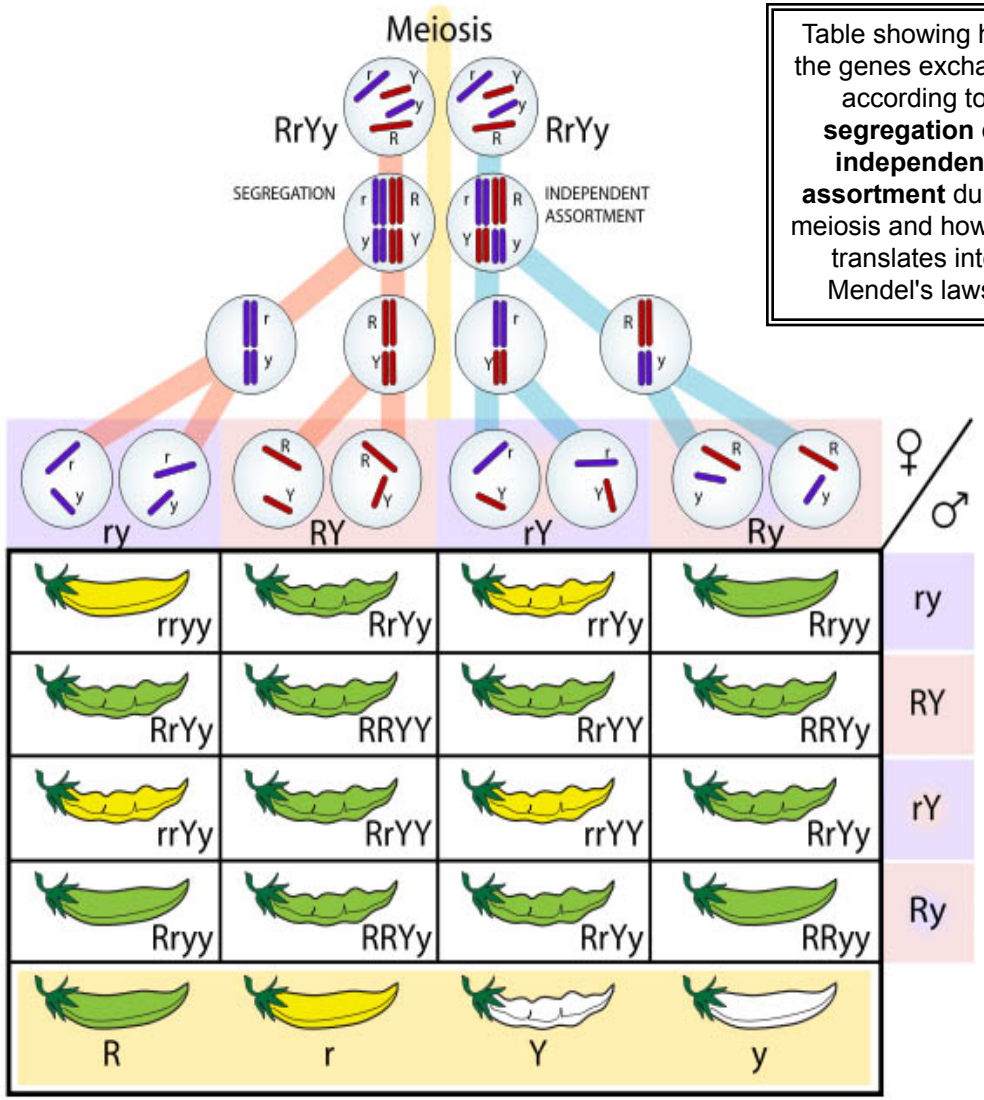


Table showing how the genes exchange according to **segregation** or **independent assortment** during meiosis and how this translates into Mendel's laws.

Image: Independent assortment and segregation diagram, Mariana Ruiz.

3. Mendel's Law of Independent Assortment

Alleles for *different* traits are distributed to sex cells (& offspring) independently of one another.

HELP! Show me a video!

Remember…Mendel came up with this stuff BEFORE we know about the existence of DNA, genes, chromosomes. WOW!

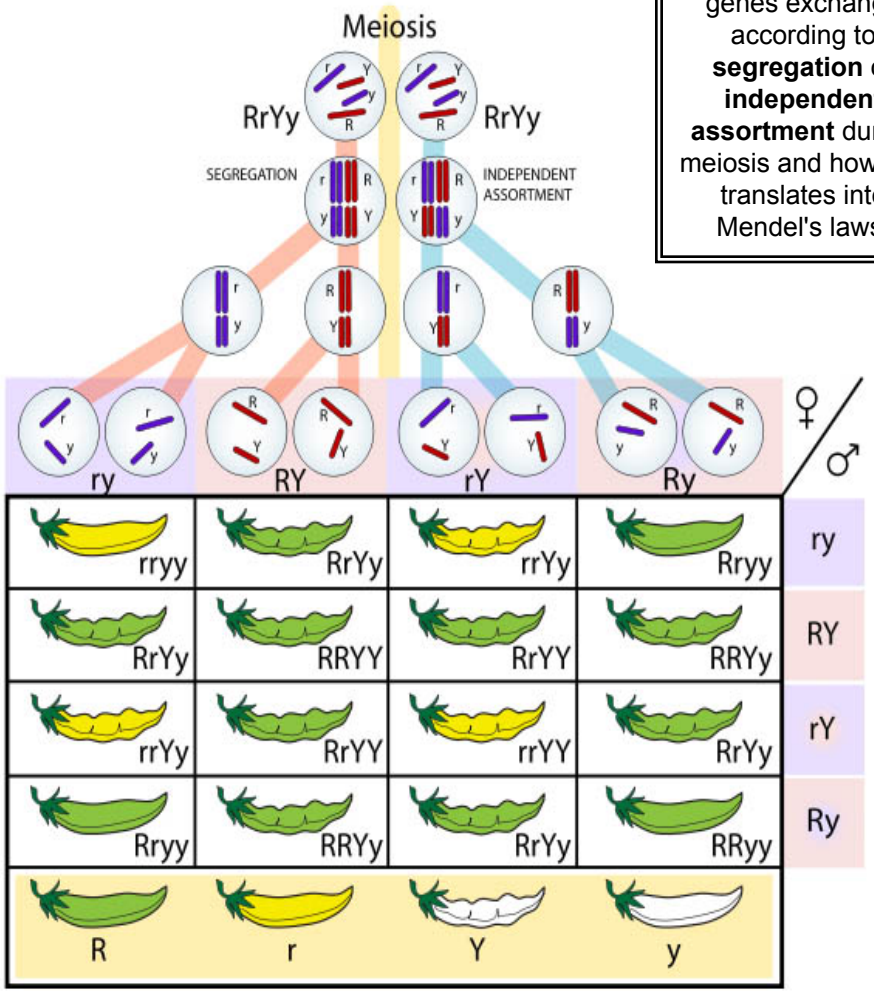


Diagram of how the genes exchange according to **segregation** or **independent assortment** during meiosis and how this translates into Mendel's laws.

Image: Independent assortment and segregation diagram, Mariana Ruiz.

Mendel's Laws:

1. **Law of Dominance:**
- In a cross of parents that are pure for contrasting traits, only one form of the trait will appear in the next generation.

- Offspring that are hybrid for a trait will have only the dominant trait in the phenotype.

2. **Law of Segregations:**
- During the formation of gametes (eggs or sperm), the two alleles (hereditary units) responsible for a trait separate from each other.

- Alleles for a trait are then "recombined" at fertilization, producing the genotype for the traits of the offspring.

3. **Law of Independent Assortment:**
- Alleles for *different* traits are distributed to sex cells (& offspring) independently of one another.

Image: Gregor Mendel, Mendel's Principles of Heredity: A Defense by Bateson, William

Figuring Out Patterns of Inheritance

A **Punnett square** is a tool for diagramming the possible genotypes of offspring.

Let do a Punnett square for the trait of bent little finger (dominant genotype), using letter "B" to represent alleles:

- DAVID (the BabyDaddy):
  - dominant phenotype [bent finger]
  - ***Q**: What is David's gentoype?*

    (NOTE: Since David is dominant for the trait, we don't know if he is homozygous or heterozygous.)

- ME (the BabyMama):
  - Recessive phenotype [straight finger]
  - ***Q**: What is my genotype?*

LEO (the BabyBaby):
- Dominant phenotype [bent finger]
- ***Q**: What is Leo's genotype?*

David's Genotype: _____

Tami's Genotype: _____

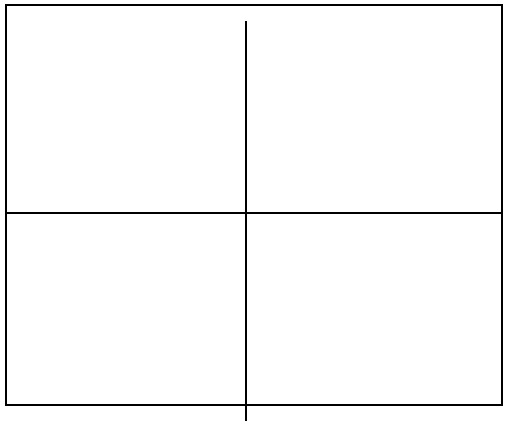
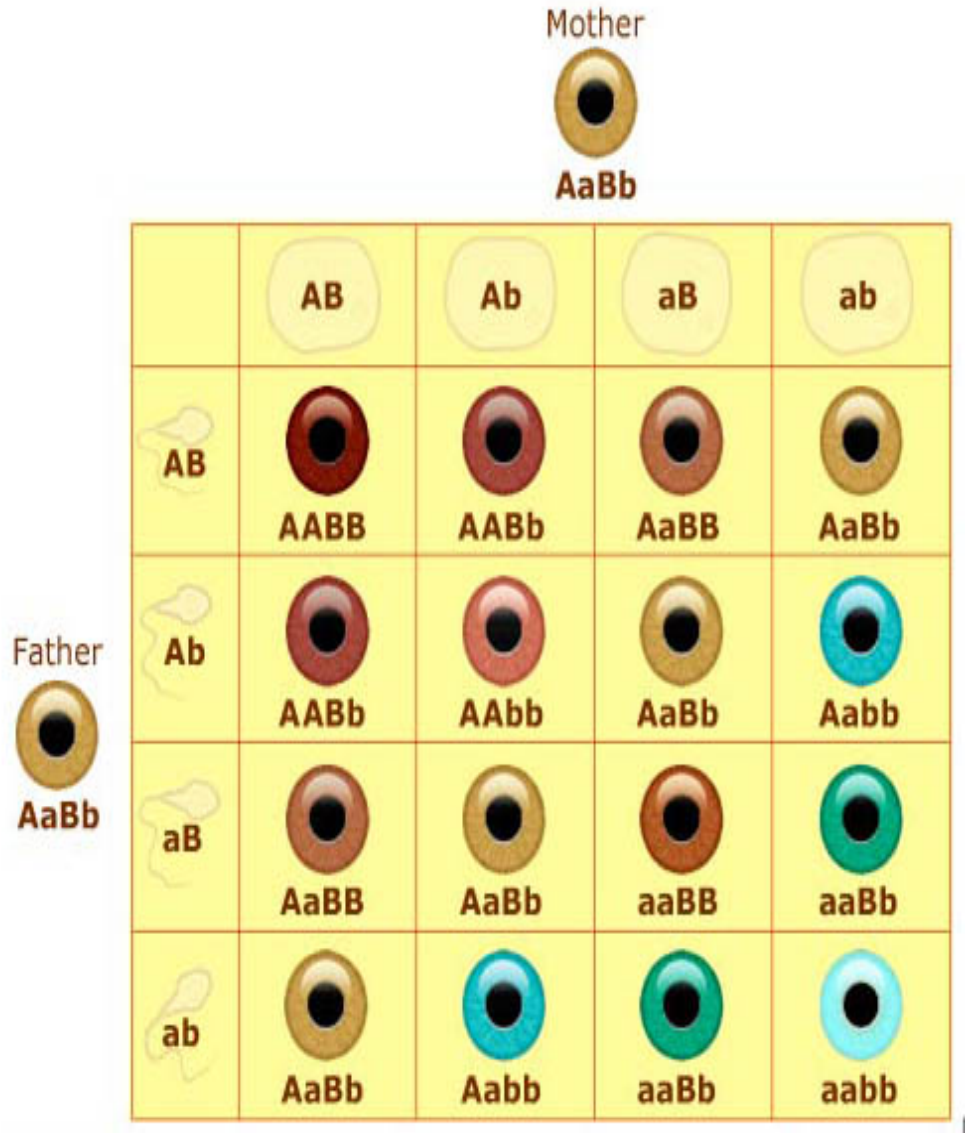


Image: Bent Little Finger" (B -), David & Leo Port



So far, we've discussed **Simple Inheritance** & **Punnett Squares**…

But, of course, genetic is much more complicated than that.

Let's explore:

- **Incomplete dominance**
- **Multiple alleles**
- **Co-dominance**

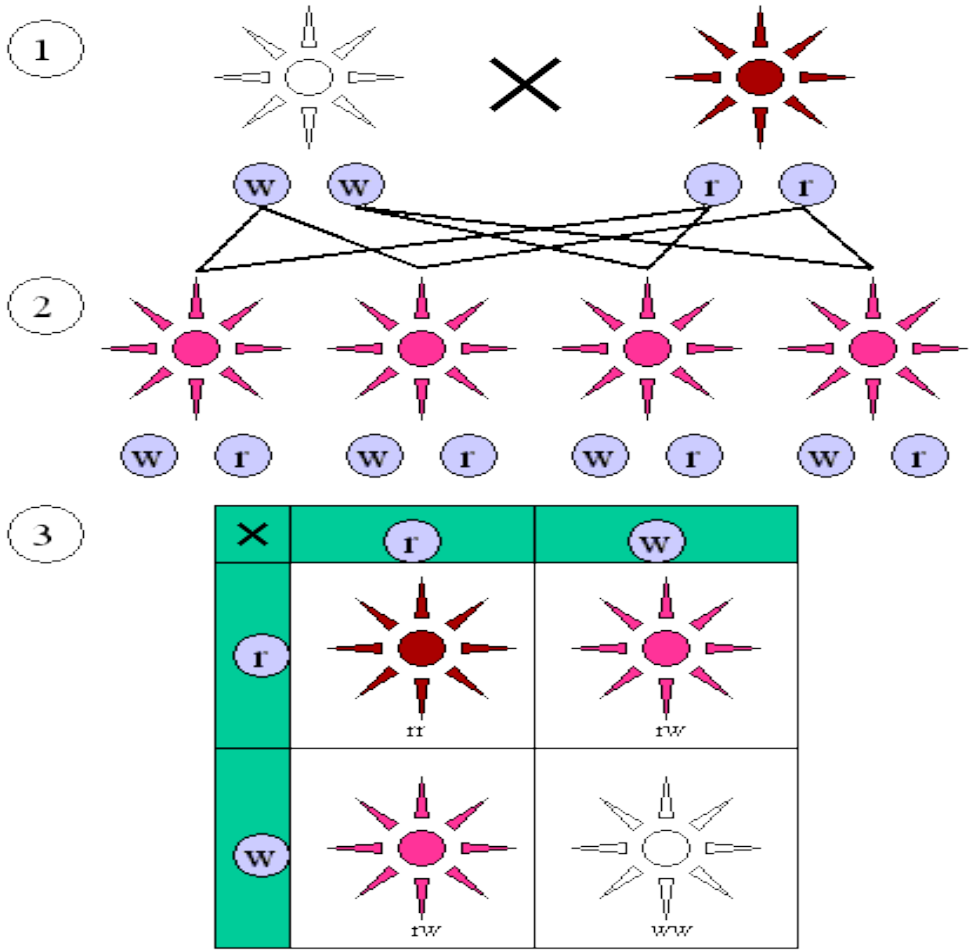
Image: Eye color, a polygenic phenotypic character, Pennsylvania State University

Beyond Simple Inheritance: Incomplete Dominance

- Patterns of dominance often go beyond simple dominant or recessive traits.
- Incomplete dominance has "degrees". It is not complete.

  F1 generation's appearance between the phenotypes of the 2 parents.

  Ex: snapdragons

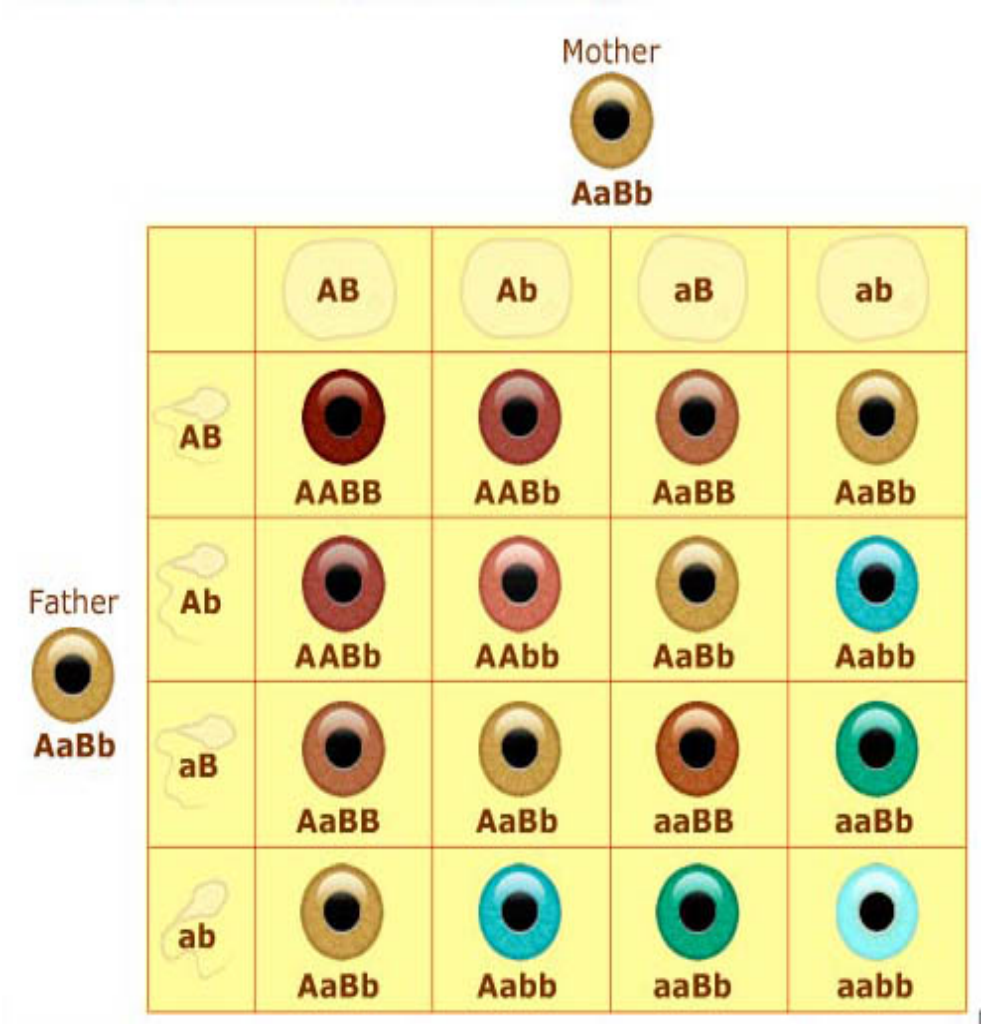


The color alleles of Mirabilis jalapa are not dominant or recessive.

(1) Parental generation. (2) F1 generation. (3) F2 generation. The "red" and "white" allele together make a "pink" phenotype, resulting in a 1:2:1 ratio of red:pink:white in the F2 generation.

Image: Incomplete Dominance, Wiki Magnus Manske

Beyond Simple Inheritance: Multiple Alleles



When there are more than two possible alleles for a gene.

Examples:

- eye color
- human blood types (ABO)

Image: Eye color, a polygenic phenotypic character, Pennsylvania State University

Beyond Simple Inheritance: Co-dominance

Two alleles affect the phenotype in separate, distinguishable ways.

Example: AB Blood Type

- has three alleles: A, B & O
- AB co-dominant, O recessive
- genotype represented using I^A, I^B & i

Phenotype	Genotype
Type A	I^AI^A or I^Ai
Type B	I^BI^B or I^Bi
Type AB	I^AI^B
Type O	ii

Image: Bleeding wound, by Crystal

Immunology Terms

Antigens

- Molecules that trigger a specific immune response.
- Include components of bacterial cell walls, plus proteins of viruses, fungi, protozoa.
- Food, pollen, and dust can also contain antigenic particles
- Enter the body by various methods
  - Through breaks in the skin and mucous membranes
  - Direct injection, as with a bite or needle
  - Through organ transplants and skin grafts

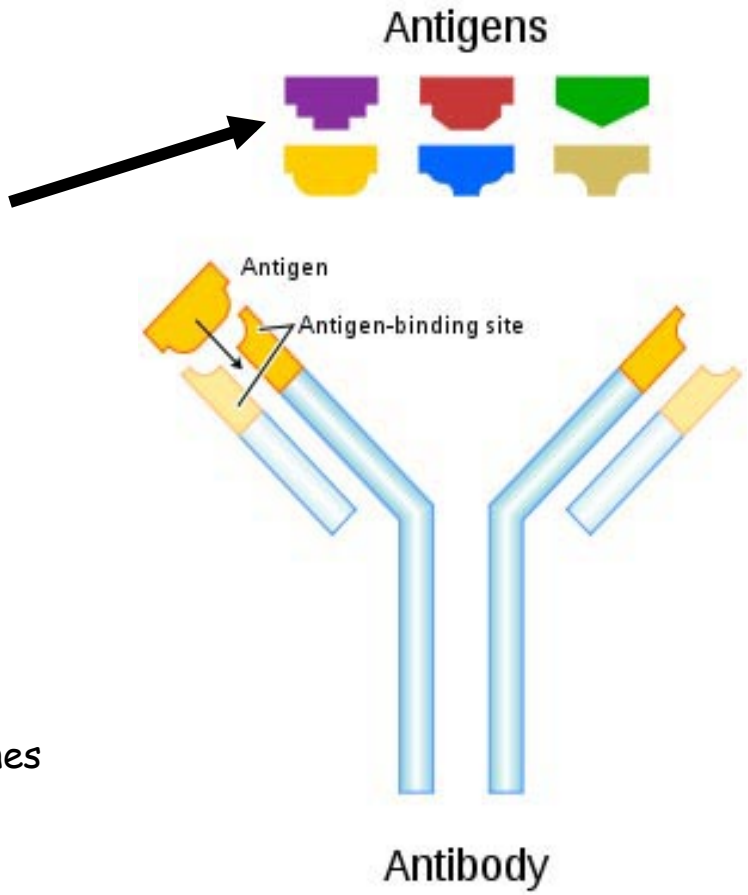
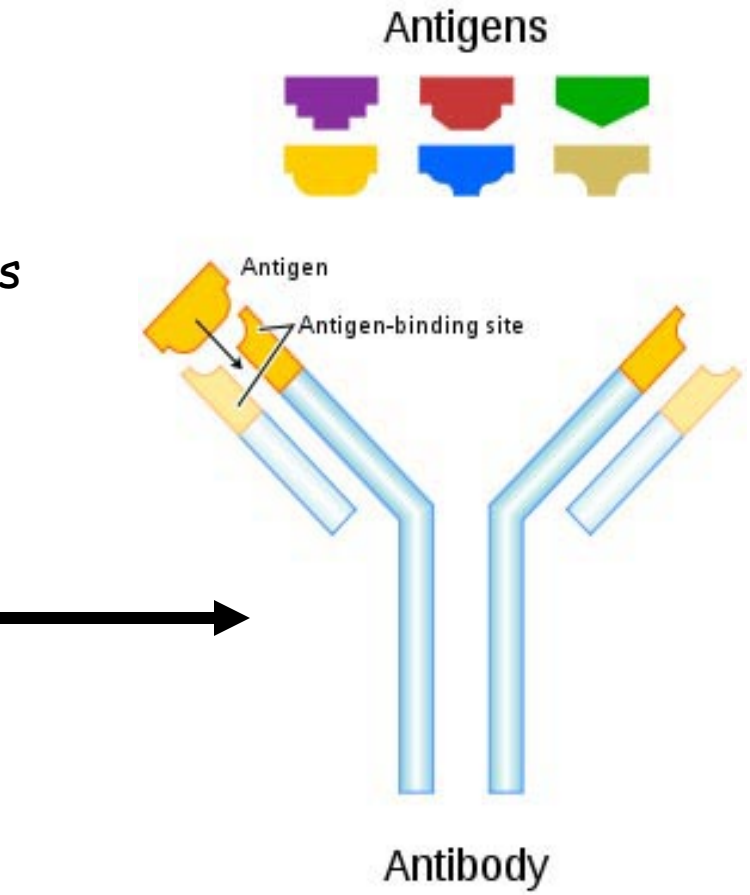


Image: Antibody & antigens, Fvasconcellos

Immunology Terms

Antibodies

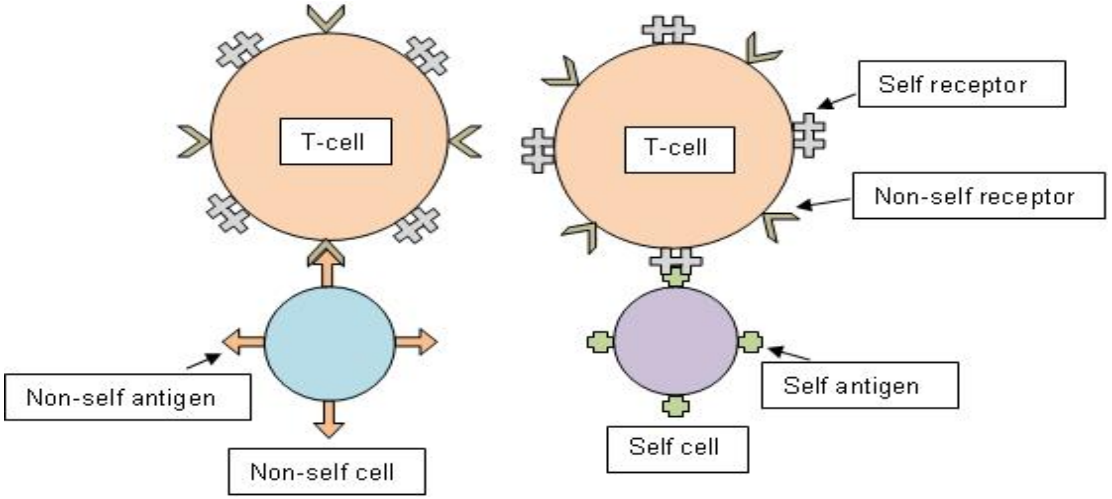
- Also called immunoglobulins (Ig)
- Proteinaceous molecules that bind antigens
- Considered part of the humoral immune response since bodily fluids such as lymph and blood were once called humors
- Can act as **labels** to identify antigens for elimination from body.
- Other anitbodies …
  - work as antitoxins
  - attach to bacterial flagella
  - cause agglutination (clumping together)



A little bit of immunology to help you understand blood types.

Immunology Terms

The interaction of antibodies and antigens is how your body tells the difference between **self** and **non-self**.



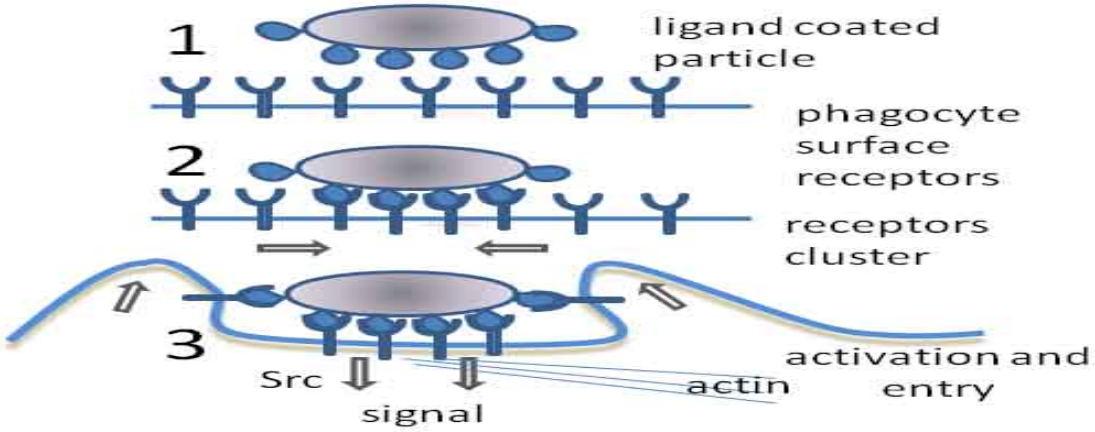


Image: Antibody & antigens, Fvasconcellos; Phagocytosis, Graham Colm

Co-domiance : ABO Blood Types

- Has three alleles: A, B & O

- AB co-dominant, O recessive

- Genotype represented using I^A, I^B & i

Phenotype	Genotype
Type A	I^AI^A or I^Ai
Type B	I^BI^B or I^Bi
Type AB	I^AI^B
Type O	ii

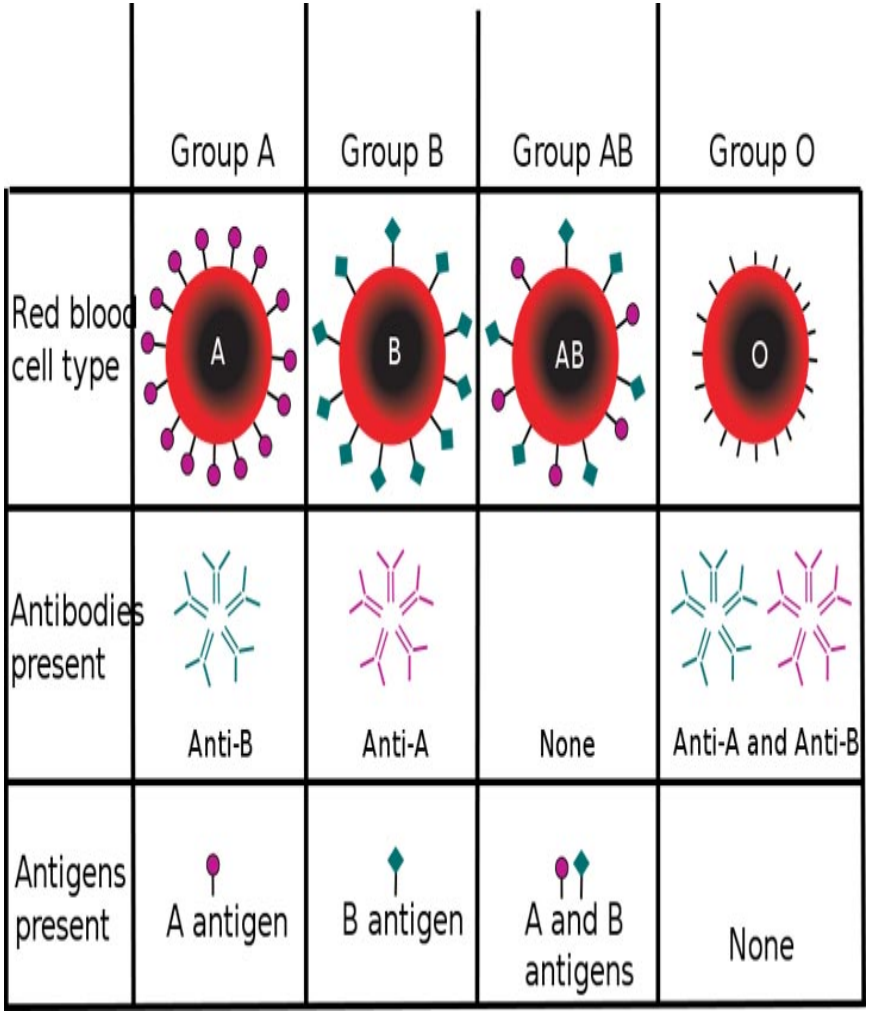


Image: ABO blood type, InvictaHOG

ABO Blood Type

You make **antibodies** *against* the **antigens** of other blood types. .

- *Q: Which blood type can accept anyone's blood.*
- *Q: Which blood type is known as the "universal donor. Why?*

Phenotype	Genotype
Type A	I^AI^A or I^Ai
Type B	I^BI^B or I^Bi
Type AB	I^AI^B
Type O	ii

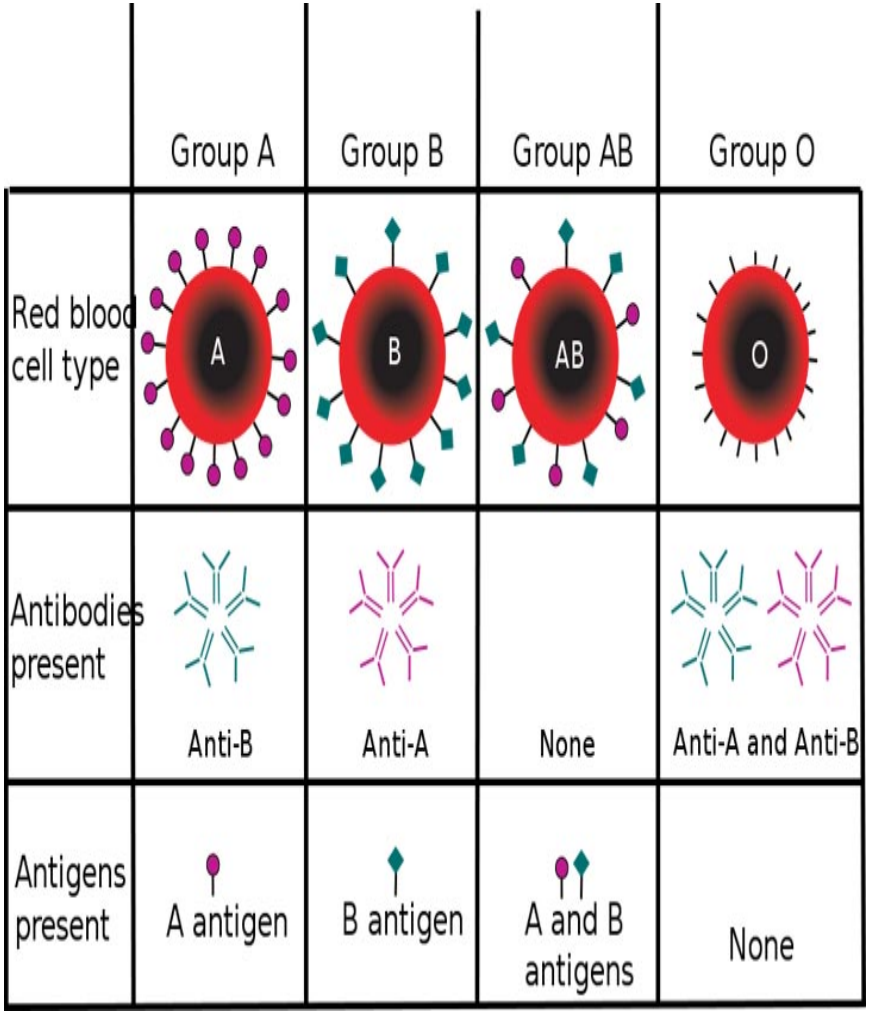
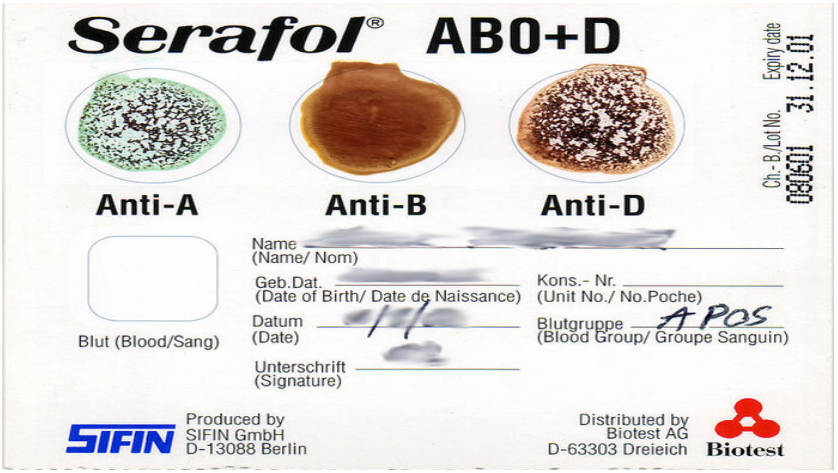


Image: ABO blood type, InvictaHOG

ABO Blood Type

If you are infused with incompatible blood, **agglutination** occurs.

The antigens in your blood bind to the antibodies of the donor blood and cause the blood to clump.



	Group A	Group B	Group AB	Group O
Red blood cell type	A	B	AB	O
Antibodies present	Anti-B	Anti-A	None	Anti-A and Anti-B
Antigens present	A antigen	B antigen	A and B antigens	None

Image: Bedside blood grouping card, AspersOn; ABO blood type, InvictaHOG

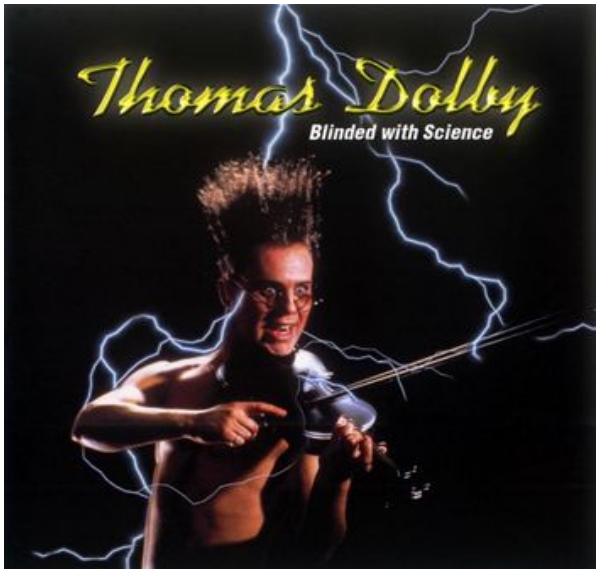
Confused?

Here are links to fun resources that further explain genetics & heredity:

Smart Links

- Genetics & Heredity Main Page on the Virtual Cell Biology Classroom of Science Prof Online.
- "Pass the Peas" song by James Brown performed by the James Brown Tribute Tour.
- Independent Assortment animation, step-through and quiz, Sinauer Associates.
- Mendel's Experiments animation, step-through and quiz, Freeman, S, Biological Science, Second Edition, Pearson Prentice Hall, Inc.© 2006
- "I Think I' m Going Bald" song by Rush.
- "Behind Blue Eyes" song by The Who.

(You must be in PPT slideshow view to click on links.)

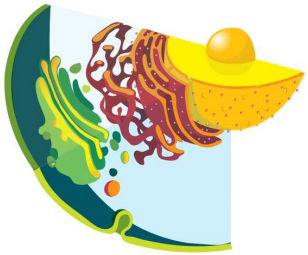


Are you feeling blinded by science?

Do yourself a favor. Use the…

Virtual Biology Classroom *(VBC)* !

The VBC is full of resources to help you succeed, including:



- practice test questions
- review questions
- study guides and learning objectives
- PowerPoints on other topics

You can access the VCBC by going to the Science Prof Online website
www.ScienceProfOnline.com

Images: Blinded With Science album, Thomas Dolby; Endomembrane system, Mariana Ruiz, Wiki