BIVALVE GENETICS PRIMER

Sea Grant Florida

R/RL-A-46

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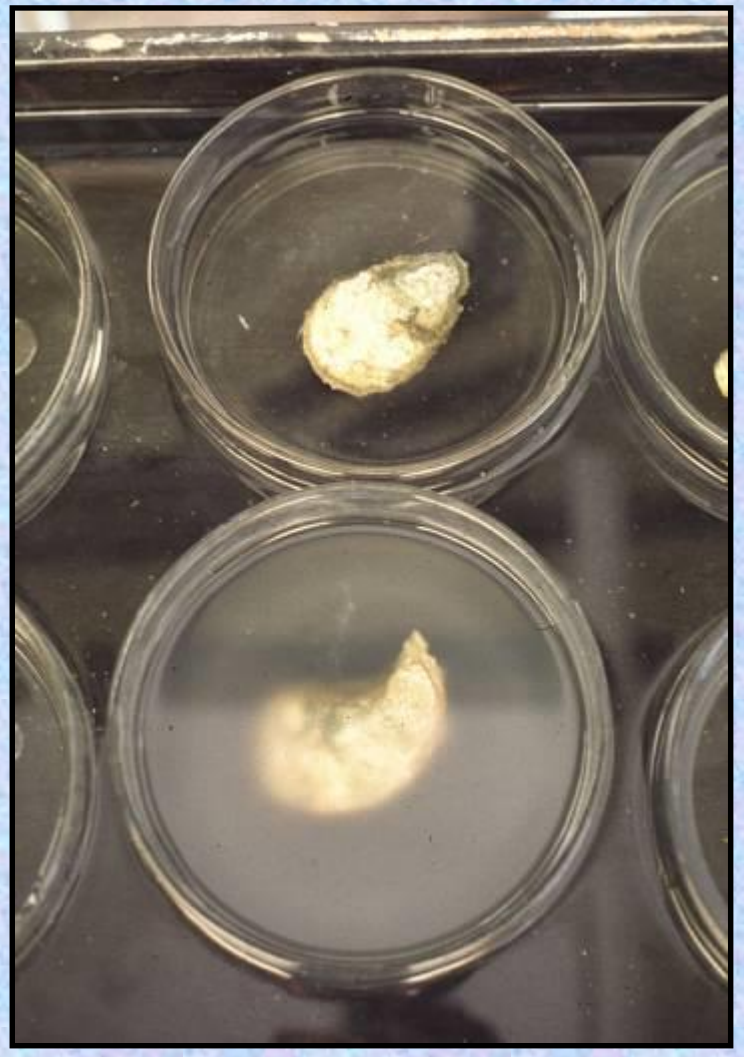
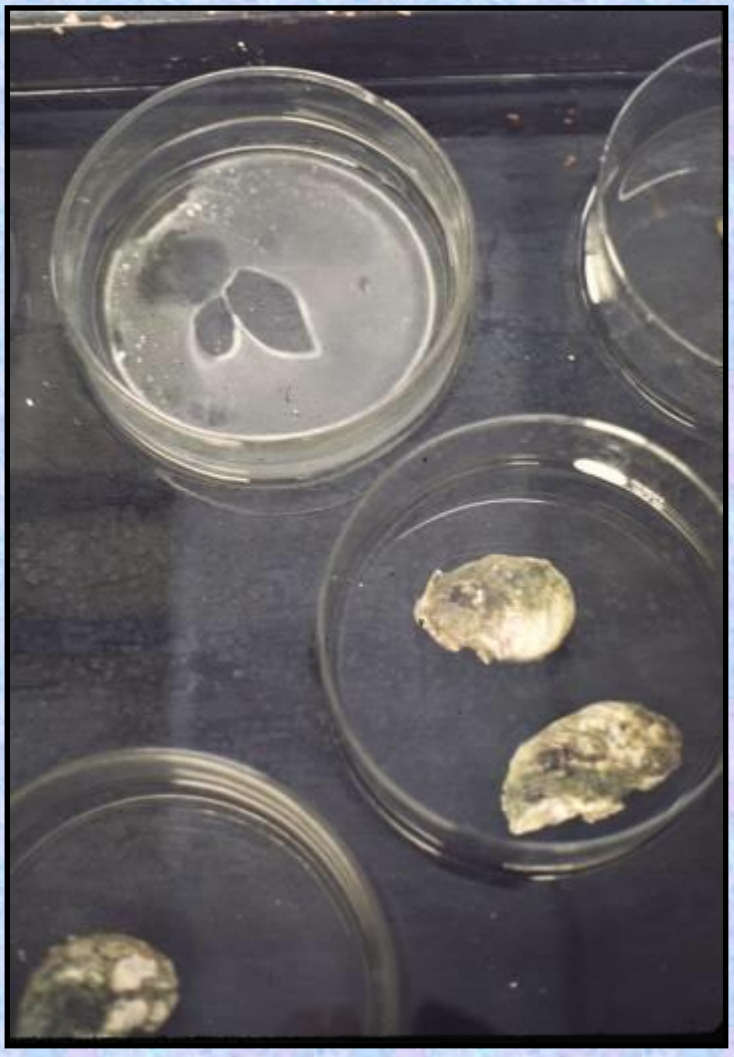
Bivalve Genome Manipulation

(not transgenic or gene transfer)



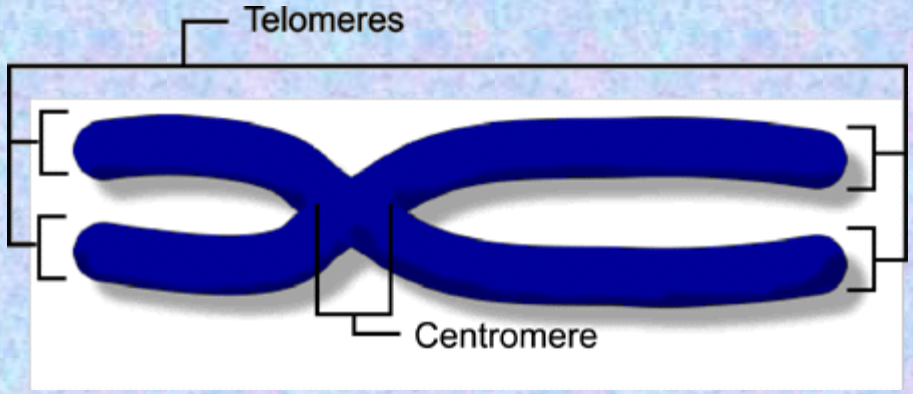


WHAT IS A GENOME?

From: www.ncbi.nlm.nih.gov/About/primer/genetics_genome.html

- A **genome** contains all of the biological information needed to build and maintain a living example of that organism.
- The biological information contained in a genome is encoded in its **deoxyribonucleic acid (DNA)** and is divided into discrete units called **genes**.
- In 1909, Danish botanist Wilhelm Johanssen coined the word **gene** for the hereditary unit found on a chromosome.
- Nearly 50 years earlier, Gregor Mendel had characterized hereditary units as **factors**— observable differences that were passed from parent to offspring.
- Genes code for proteins that attach to the genome at the appropriate positions and switch on a series of reactions called gene expression.
- Today we know that a single gene consists of a unique sequence of DNA that provides the complete instructions to make a functional product, called a protein.
- Genes instruct each cell type— such as skin, brain, and liver—to make discrete sets of proteins at just the right times, and it is through this specificity that unique organisms arise.

CHROMOSOMES



- A chromosome is composed of a very long molecule of DNA and associated proteins that carry hereditary information.
- The centromere, shown at the center of this chromosome, is a specialized structure that appears during cell division and ensures the correct distribution of duplicated chromosomes to daughter cells.
- Telomeres are the structures that seal the end of a chromosome.

Mechanisms of Genetic Variation and Heredity

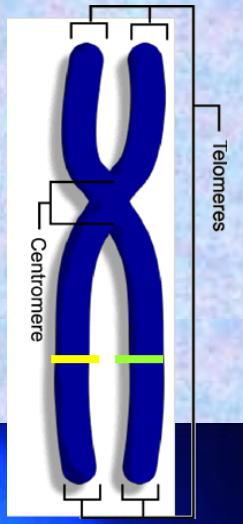
- When you look at any species, you see evidence of a process called **genetic variation**, that is, there are immediately recognizable differences in traits, such as eye and hair color in humans. Then there are the not so obvious genetic variations, such as blood type.
- These expressed, or **phenotypic**, traits are attributable to **genotypic** variation in a person's DNA sequence.
- When two individuals display different phenotypes of the same trait, they are said to have two different **alleles (variants)** for the same gene. This means that the gene's sequence is slightly different in the two individuals, and the gene is said to be **polymorphic**, "**poly**" meaning many and "**morph**" meaning shape or form.
- Therefore, although organisms generally have the same genes, the genes do not have exactly the same DNA sequence. These polymorphic sites influence gene expression and also serve as markers for genomic research efforts.
- Where does Genetic Variation come from?

Meiosis versus Mitosis

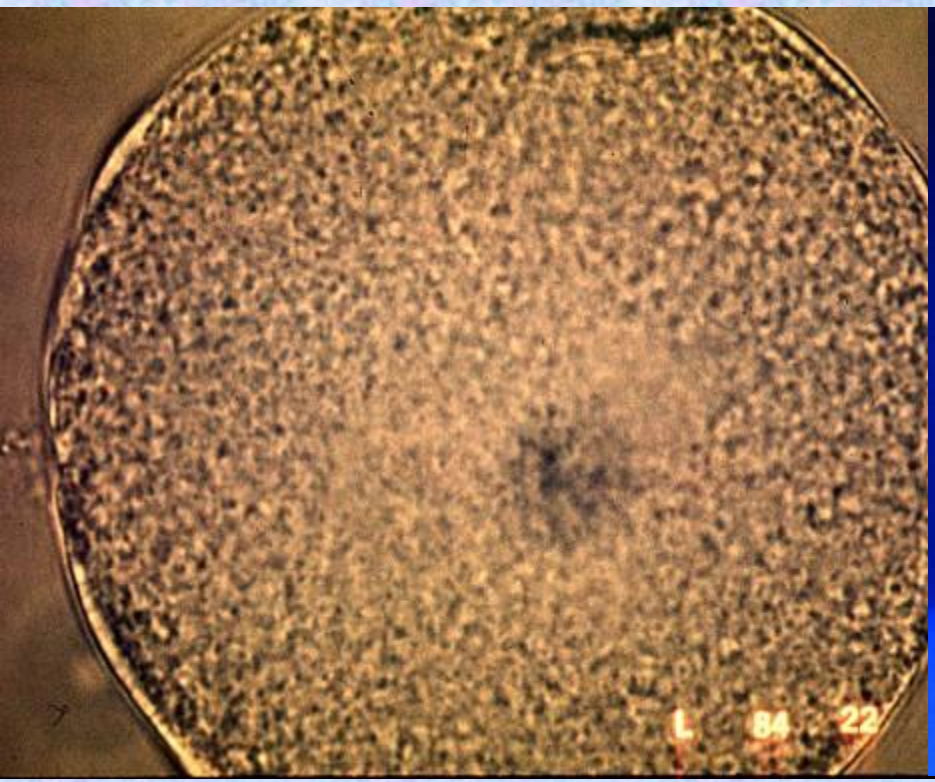
- **Meiosis - cell replication that takes place in the gonads, which results in cells with an haploid genome.**

- **Mitosis - cell replication that takes place in somatic tissues, which results in exact duplicates of itself (i.e., diploid daughter cells).**

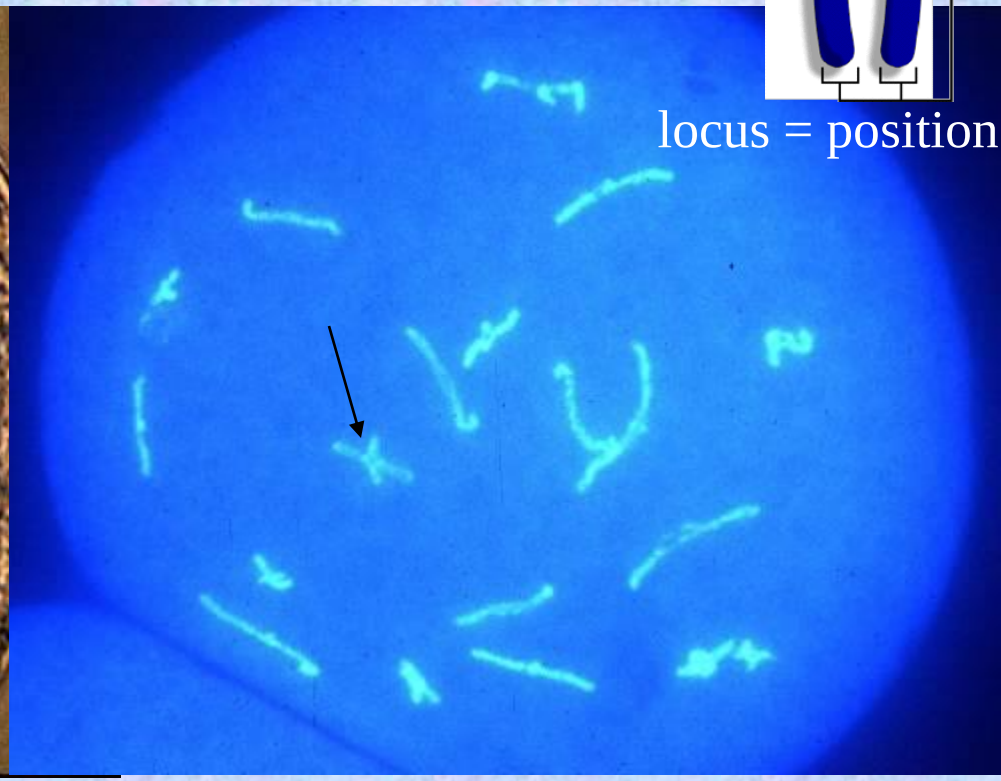
Meiotic Maturation



Oocyte



Prophase



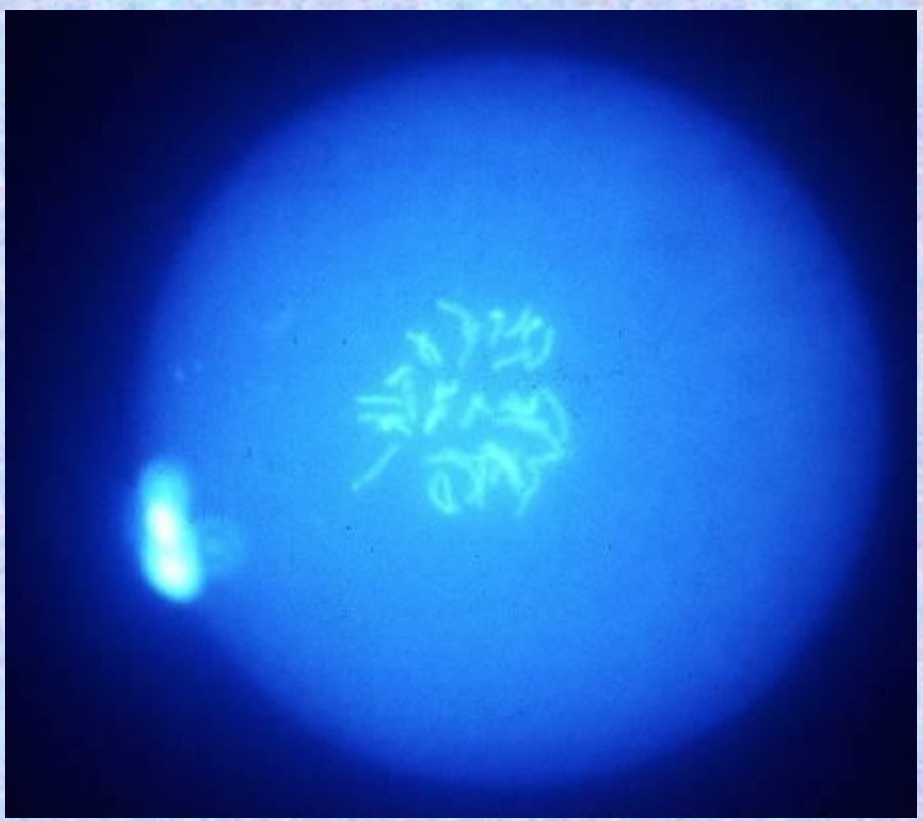
locus = position

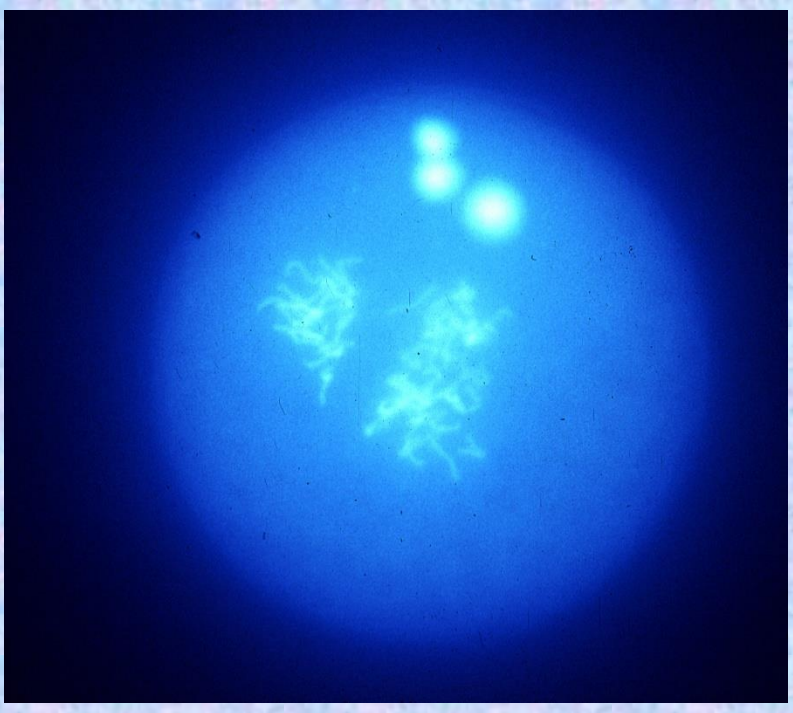
(Chiasmata - crossover, ♀ variation)

Meiotic Maturation

Activation

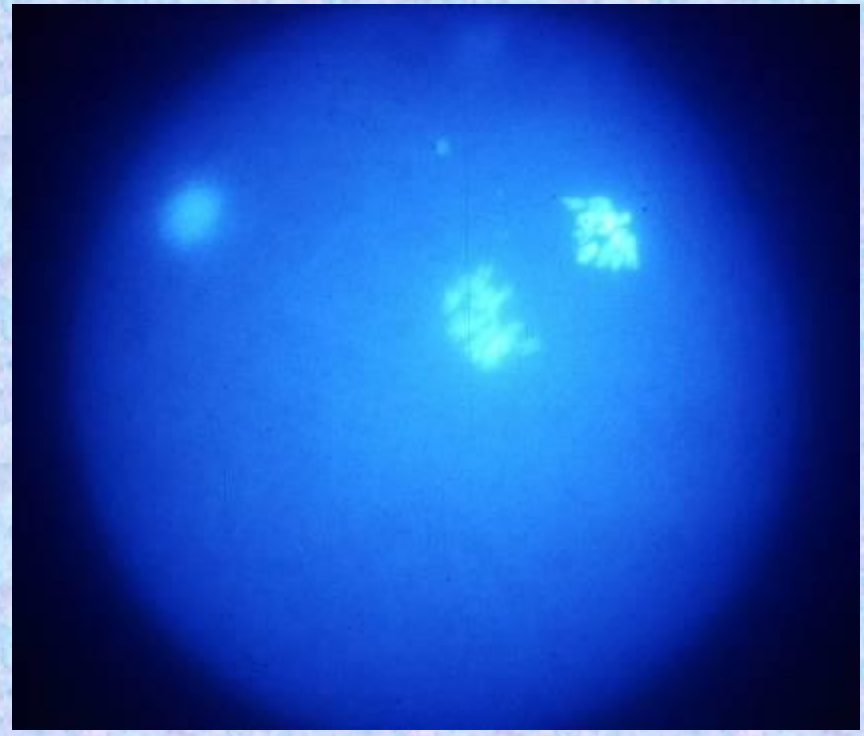
Metaphase

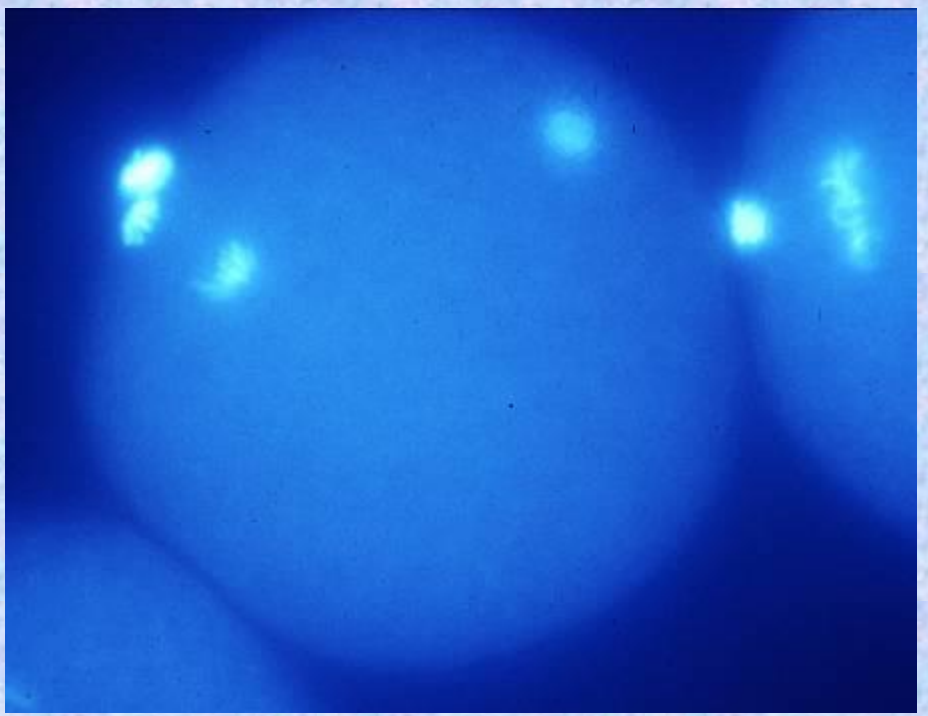




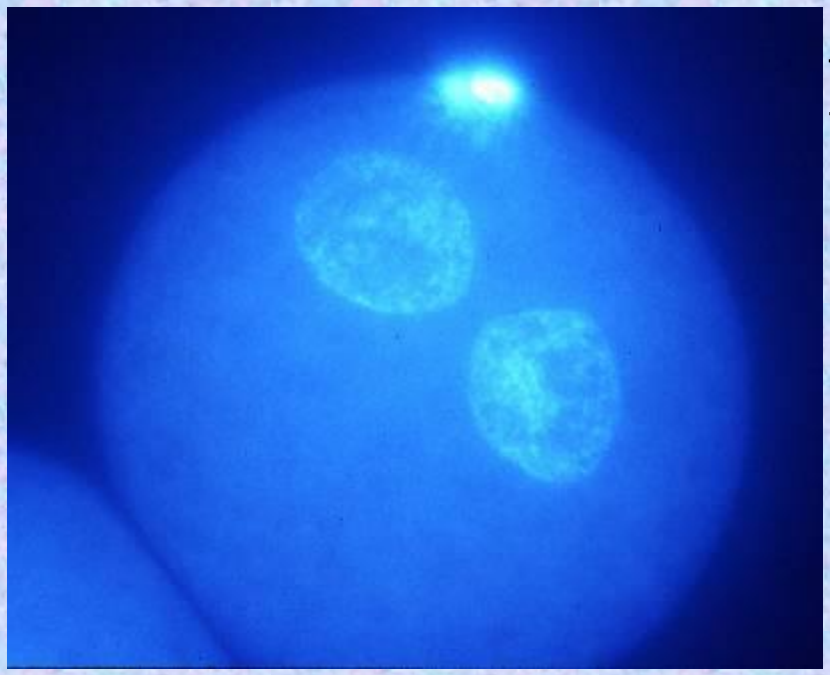
Anaphase

Telophase I, PBI



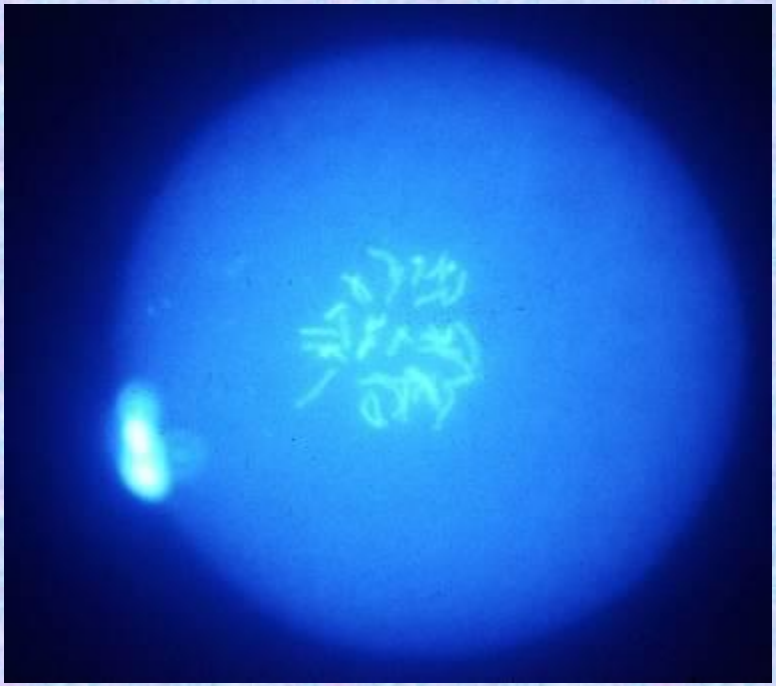


Telophase II, PBII

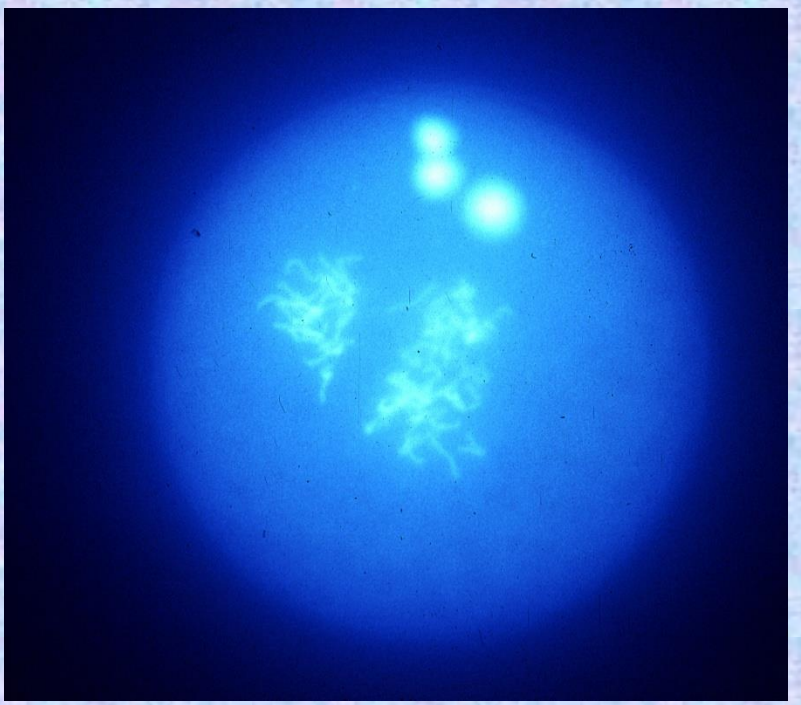


Pronulcei Formation

Pronulcei Fusion

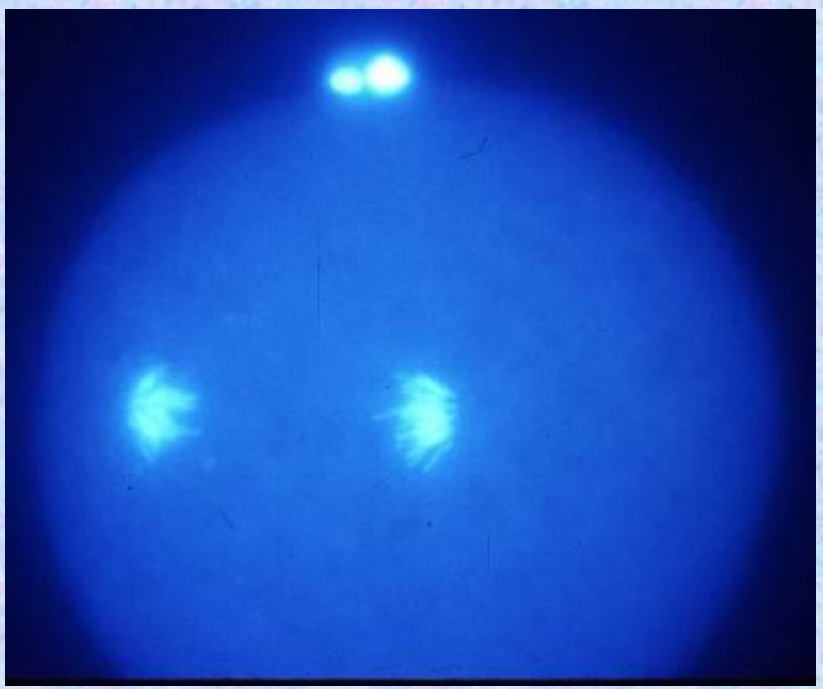


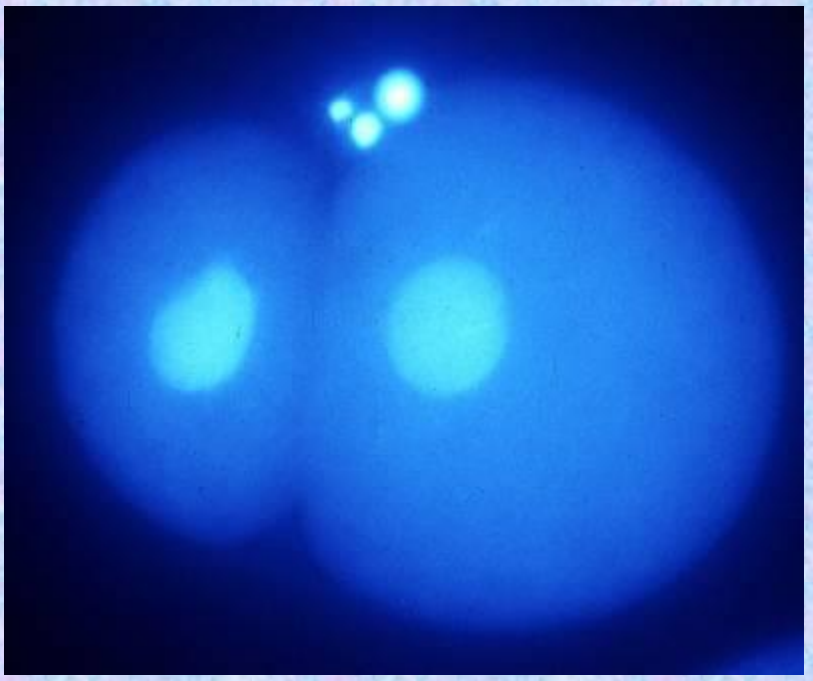
Syngamy = Fertilization,
Mating Variation,
Mitotic Metaphase



Anaphase

Telophase





2-cell stage...

Genome Manipulations

- **Hybridization**
- **Polyploidy**
- **Gynogenesis**
- **Androgenesis**

HYBRIDIZATION

= crossing genetically dissimilar parents

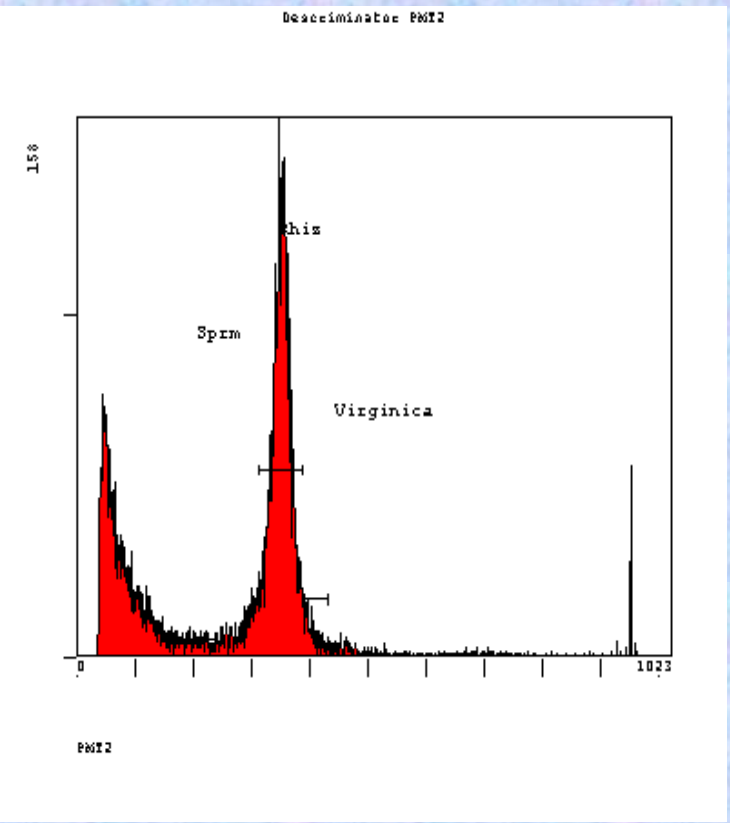
- intra-specific: strains, North x South

- inter-specific: American x Caribbean

- inter-generic: *Spisula* x *Mulinia*

Species confirmation:

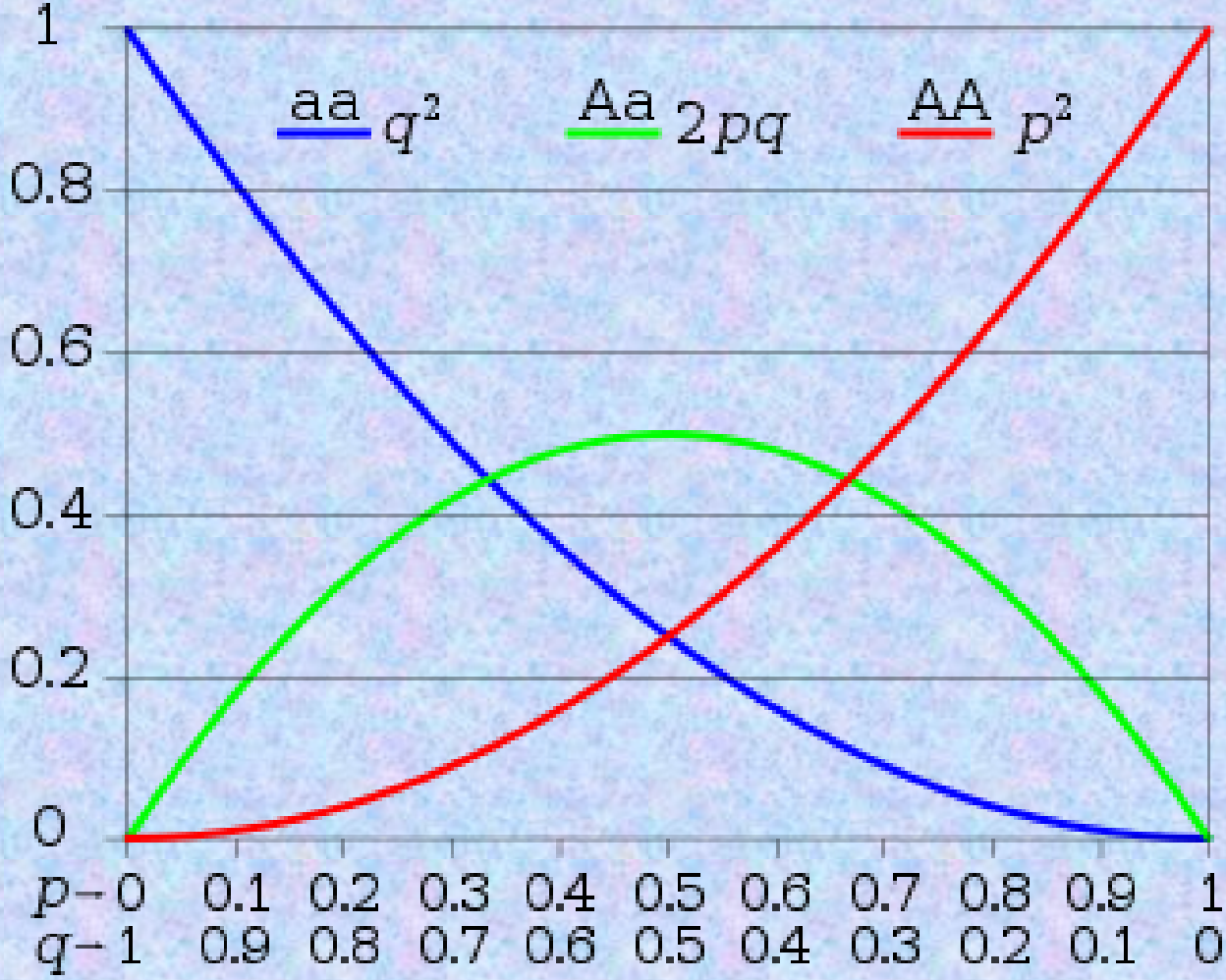
- *C. rhizophorae*
  - Fosforescent Bay, PR
- *C. virginica*
  - Cedar Key, FL
- FCM DNA content
  - C. rhizophorae < C. virginica (~15%)



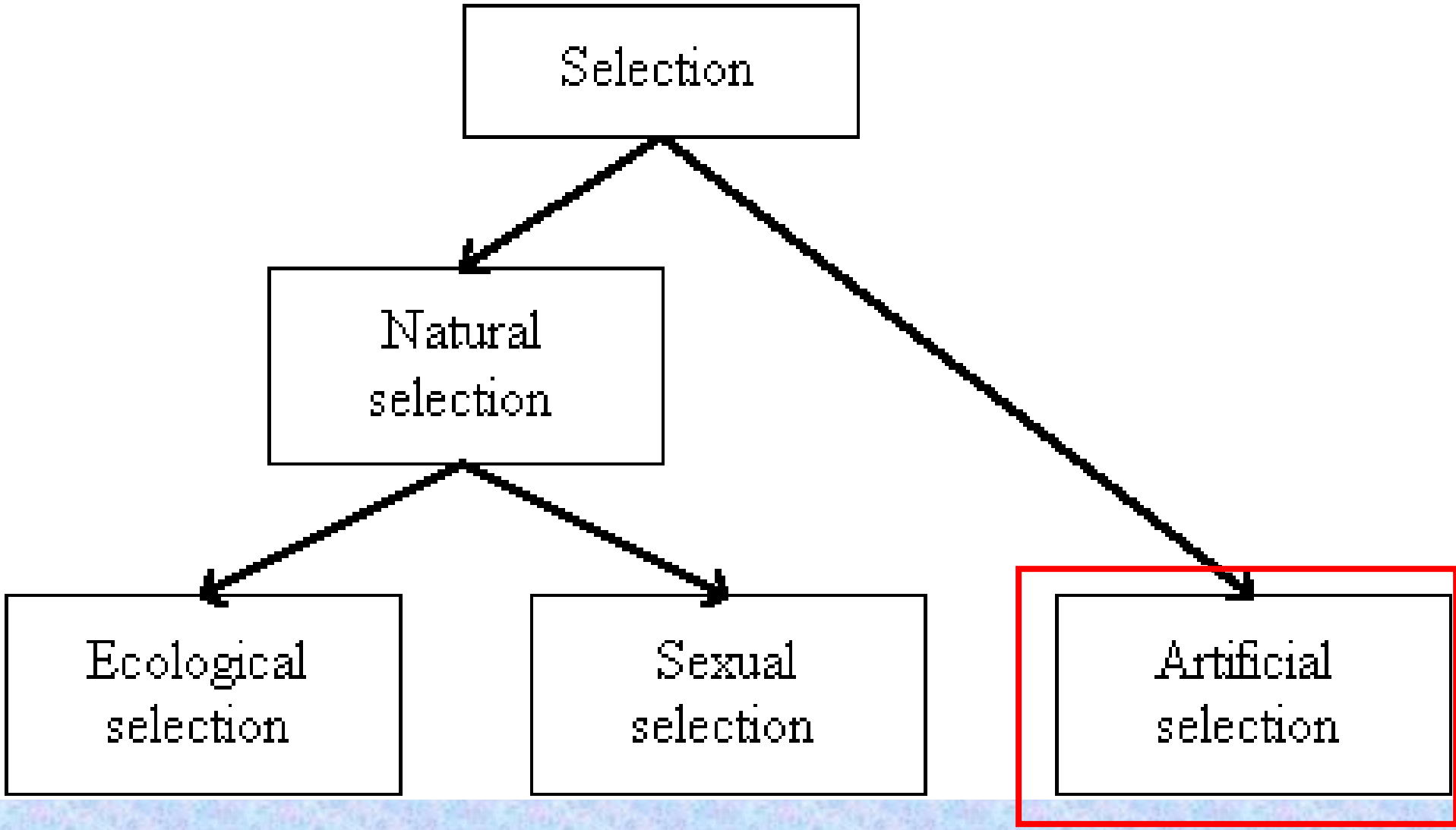
Statistic	Number	%Total	%Gated	X-Mean	X-Mode	X-CV	HP X-CV
Descriminator-->Rhiz	5011	50.11	51.45	350.4	348.0	4.5	3.0
Descriminator-->Sprm	479	4.79	4.92	186.1	146.0	14.5	0.8
Descriminator--> Virginica	306	3.06	3.14	404.7	396.0	3.0	0.6
UnGated-->Descriminator	9740	97.40	97.40	244.7	31.0	60.6	23.5

Hybridization - Benefits

- **Trait Transfer**
- **Coloration**
- **Sterility**
- **Behavioral**



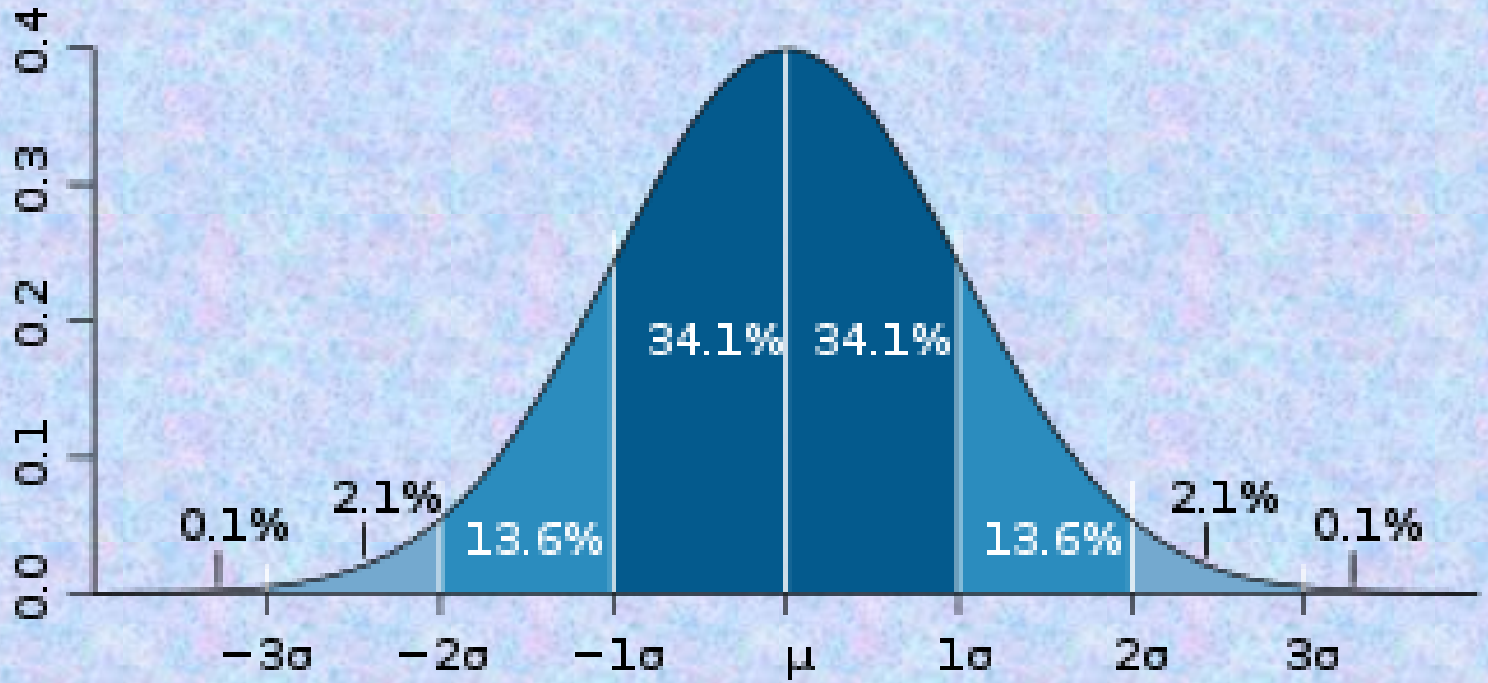
Hardy–Weinberg genotype frequencies for two alleles: the horizontal axis shows the two allele frequencies *p* and *q* and the vertical axis shows the genotype frequencies. Each curve shows one of the three possible genotypes. http://en.wikipedia.org/wiki/Population_genetics



Selection is hierarchically classified into natural and artificial selection. Natural selection is further subclassified into ecological and sexual selection.

http://en.wikipedia.org/wiki/Selection

NORMAL DISTRIBUTION



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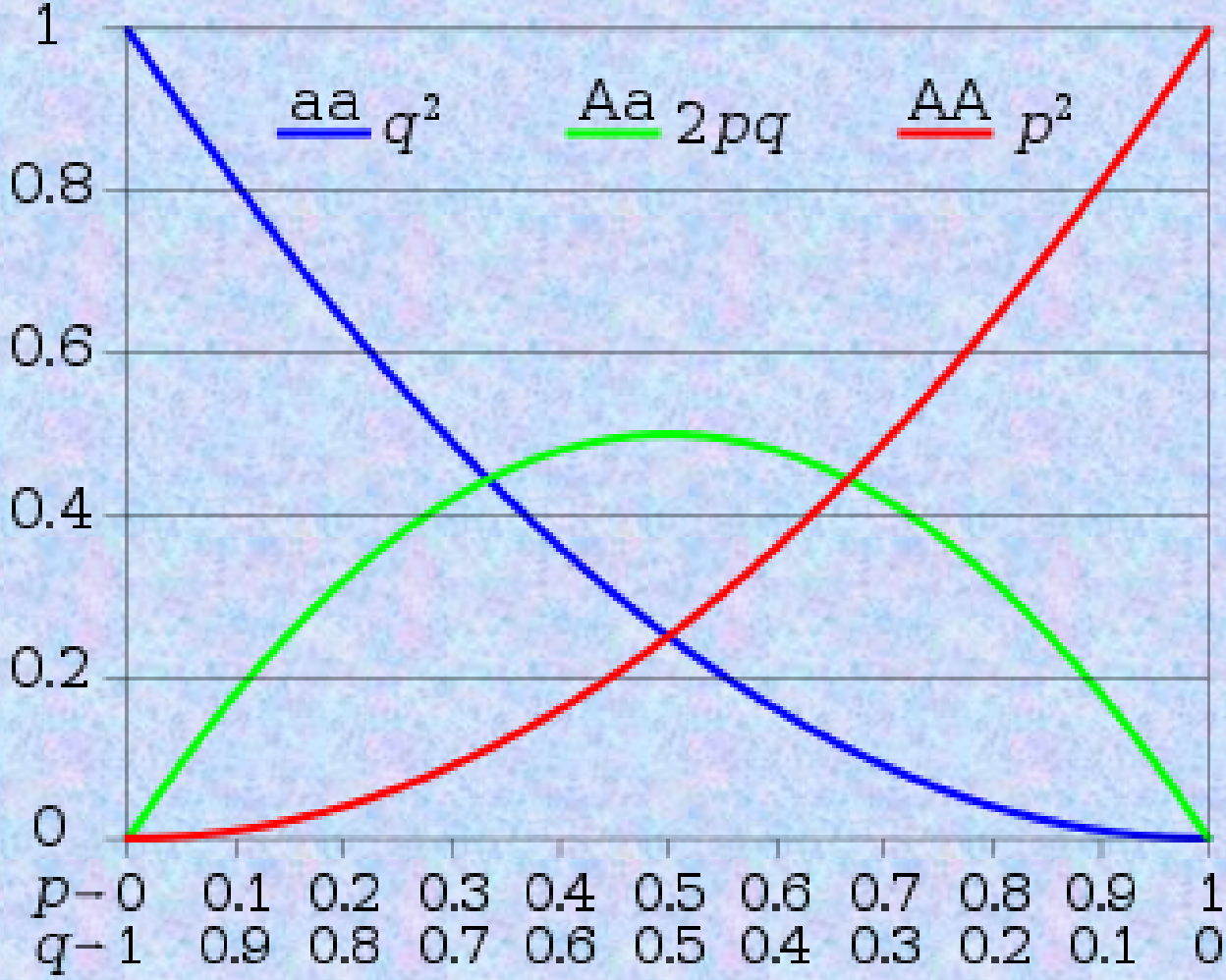

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