

Chapter 3 Genetics: The Science of Heredity



Section 1 Mendel's Work

Gregor Mendel – Priest from central Europe who used peas to study traits – his work formed the foundation of genetics

Traits = different physical characteristics

Heredity = passing of traits from parents to offspring

Genetics = scientific study of heredity



Pea plants were easy to study because:

- a) they have many different traits that exist in only two forms
- b) produced a large # of offspring in one generation (to have a large sample size)
- c) can self pollinate or he could control if they cross pollinated
- d) and they grow quickly.



Mendel's Experiment

-started with purebred plants = always produces offspring with the same trait

-First crossed tall with short = resulted in all tall plants in F1

-Parental generation = P

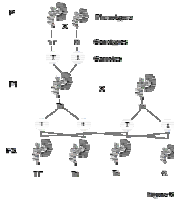
-Offspring 1st generation = F1

-Allowed F1 to self pollinate to create F2 generation

-Results were mix of tall and short



- Found that $\frac{3}{4}$ were tall and $\frac{1}{4}$ were short in F2



-also studied 6 other traits and crossed them in the same way as he did height

-All F1 had 1 trait but F2 $\frac{1}{4}$ were different

Dominant and Recessive Alleles

Genes = Factors that control traits

Alleles = Different forms of a gene for different traits

-Individual alleles control the inheritance of traits

-Can be dominant or recessive



I am glad I don't share all your dominant alleles

-Dominant = the trait that always shows up when the allele is present

-We use a Capital letter to represent (T)

-Recessive = is covered up if dominant allele is present - only show up when both are present

-We use a Lowercase letter to represent (t)

I still look good!



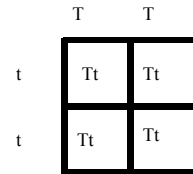
Yes Dad my boyfriend is an albino. It is a recessive trait.

Understanding Mendel's Crosses

- F1 Generation where hybrids because they have two different alleles (gene type) for one trait

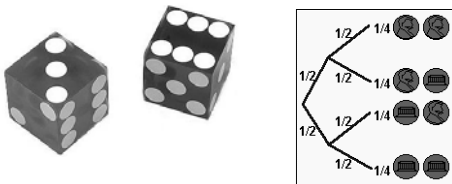
- Only the dominant allele is expressed (seen)

- All we see is tall plants

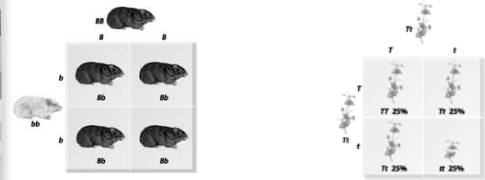


Section 2 Probability and Genetics

Probability = likelihood that a particular event will occur – can be used to predict the results of a genetic cross



Punnett Square = a chart that shows all the possible combinations of alleles

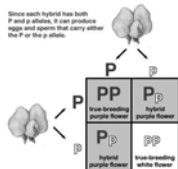
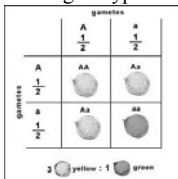


Genotype Vs. Phenotype

Phenotype = visible traits – ex) purple or white flower

Genotype = genes it carries – ex) PP, Pp, pp

- an organism can have the same phenotype but different genotypes



Multiple Alleles

-Codominance = one allele is not dominant over the other AND BOTH ALLELES EXPRESSED EQUALLY

-Example: Blood Type

-Not a third intermediate phenotype like incomplete dominance

A = Dominant

B = Dominant

AB = Codominant

O = Recessive

Phenotype (blood type)	Genotype	Antibodies in serum
A	AA or AO	Anti-B
B	BB or BO	Anti-A
AB	AB	None
O	OO	Anti-B and Anti-A

Incomplete Dominance

- Incomplete Dominance = Neither allele is dominant over the other
- Now three phenotypes are possible by the combinations of genotypes
- Third phenotype is intermediate between the other two



Section 3 The Cell and Inheritance

- Walter Sutton learned first that grasshoppers egg and sperm each had 12 chromosomes
- Fertilized egg made 24 – the same for a grasshopper
- 24 chromosomes made 12 pairs

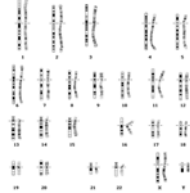


- Concluded that Mendel's heredity factors (genes) were located on the chromosomes
- Chromosome theory of inheritance = genes are carried from parents to their offspring on chromosomes



Meiosis

- this is the process of how the number of chromosomes are reduced by half to form sex cells
- REMEMBER – you get half your chromosomes from each parent (half their genetics)
- Humans always have 46 chromosomes (23 pairs)



- 2 sets of chromosomes from the parents can combine in many different ways depending on how they line up at the equator during meiosis I
- Passing of traits from parent to offspring is called HEREDITY



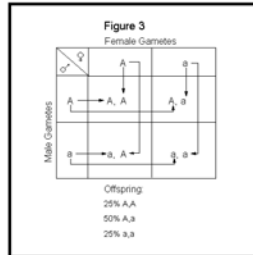
- whenever offspring are produced by sexual reproduction, they vary from one another and their parents



Meiosis and Punnett Squares

-using Punnett Squares is a shorthand way to show Meiosis

-Chromosomes pair up and separate with one allele going to each sex cell

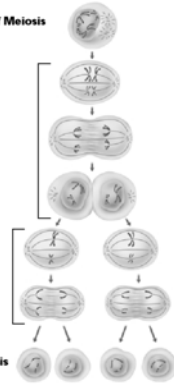


Beginning of Meiosis

Meiosis I

Meiosis II

End of Meiosis



Chromosomes

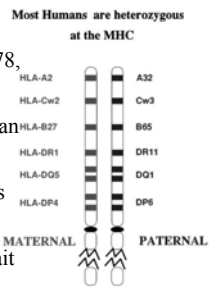
-Humans always have 46 chromosomes (23 pairs), dogs 78, silkworms 56, etc.

-More chromosomes do not mean more advanced

-Humans have 46 chromosomes but have over 60,000 genes

-Each gene controls a partial trait

-Can be heterozygous for some traits and homozygous for others



HOW MANY GENES DOES IT TAKE TO MAKE A BODY?

Although gene therapists have run into snags, scientists trying to map the human genome are making rapid progress. A genetic atlas published last week shows the number of distinct genes active in various parts of the body. The more complex the organ or tissue, the more genes are required.



Section 4 The DNA Connection

The Genetic Code

-Genes control the production of proteins in the organisms cells

-Proteins determine the size, shape, traits, etc for each organism and each cell in an organism



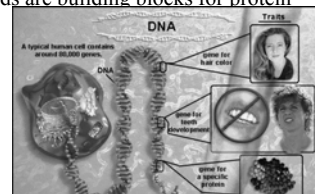
-Remember chromosomes are mostly made of DNA

-DNA has 4 different nitrogen bases A, T, G, C

-Order of these bases form the genetic code for what type of protein will be made

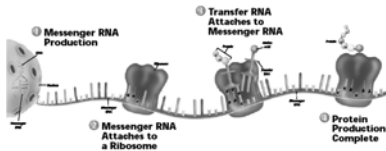
-Each 3 bases code for 1 amino acid

-Amino acids are building blocks for protein



How Cells Make Proteins

- cells use information from a gene on a chromosome to produce a specific protein
- Protein synthesis takes place on the ribosomes = outside of the nucleus
- DNA can not leave the nucleus so it uses messenger RNA to copy it and bring info out of the nucleus



RNA = Ribonucleic Acid – is single stranded – instead of thymine it has Uracil

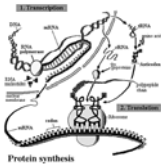
Messenger RNA (mRNA) = the copy of DNA that leaves the nucleus

Transfer RNA (tRNA) = carries amino acids and adds to the growing protein



Translating the Code

- 1) DNA unzips between base pairs and mRNA copies
- 2) mRNA leaves the nucleus and attaches to a Ribosome
- 3) tRNA pick up amino acids specified by each 3 letter code and attaches them together



Mutations

= any change in DNA or gene

-will produce an incorrect protein

-results = organisms traits or phenotype will be different

- Will pass on this trait if the mutation is on a sex cell

-THIS IS THE BASIS FOR EVOLUTION – if the new phenotype is better it will live longer and pass on this new trait

-mutations can be from random changes that include additions, deletions, and substitutions of nucleotides and rearrangement of chromosomes

-many mutations are minor or neutral

-other mutations are beneficial or harmful

-selective breeding can not eliminate genetic diseases or unwanted traits from a population because of new, spontaneous mutations

