Bio 10TR Lecture Notes 4 Dr. Schmidt

Chapter 6

Mitosis & Meiosis

Cell Division

1. Prokaryotes

Binary Fission - cell division increases the number of individuals in the population

Endosymbiotic theory: chloroplasts and mitochondria have their own chromosome

2. Eukaryotes

mitosis – asexual reproduction

meiosis – sexual reproduction

the cell cycle: the growth and division of eukaryotic cells

 all the stages of the life cycle of a cell

Chromosomes

1. Ploidy

haploid - 1n

diploid - 2n

polyploid - 4n, etc.

 2. DNA

cromatids,

chromosomes

Sexual vs Asexual Reproduction

Mitosis vs Meiosis

1. Mitosis: asexual reproduction aka vegetative reproduction

common in plants and lower animals

cell “cloning”

2. Meiosis: sexual reproduction aka reduction division

gametes – sex cells

haploid ploidy

Meiosis in humans

 Sources of genetic material

nuclear: humans have 46 chromosomes, 22 pairs of autosomes & two sex

extra-nuclear: mitochondrial DNA

 Errors in replication – often fatal

nondisjunction: one of the most common errors

 failure of chromosomes to separate

Down’s syndrome, 3 copies of chromosome #21

also, sex chromosomes (XXY, XXX, etc.)

Stem Cells & Cancer

1. Normal Cell Cycle – benign vs malignant tumors, metastasized cells

2. Cell Signaling and stem cells

3. Telomeres – normal cells only divide 50 times

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Chapter 7

Genetics & Inheritance

Gene theory

1. Gregor Mendel:

Experiments with pea plants: seed, flower, and pod color, flower position, stem length

Self Pollination

Some discrete factors or elements are passed from one generation to the next

Conducted experiments logically and systematically, choose easily observable traits, studied multiple generations, analyzed results mathematically, and published data

Published reports of experiments in 1865

2. Cytology: the study of cell structure

Walter Sutton, 1902, hereditary factors described by Mendel are carried on chromosomes

 he noted the pairing of chromosomes during meiosis

Classical genetics - study of heredity through analyzing crossings and offspring

Mendel's first law

1. Principle of segregation: genetic traits are carried as pairs of factors, and the pairs separate from each other during the formation of gametes.

Dominant traits: phenotypic effect of allele is the same for both homologous and heterologous genotypes (TT and Tt are both tall)

Recessive traits: phenotypic effect of allele is masked by the dominant heterologous genotype (only tt is short)

Generations

P - parental generation

F1 - first generation of offspring

F2 - second generation of offspring

Fn - subsequent generations of offspring

Alleles: two forms of a gene

homozygous: two alleles are the same for a particular trait (YY or yy)

heterozygous: two alleles are not the same for a trait (Yy)

Phenotype: outward appearance and observable characteristics of an organism

Genotype: the actual genetic makeup of an organism

2. Testcrossing experiments

Punnett square

Mendel's second law

1. Principle of independent assortment: when gametes are formed, alleles of each gene segregate independently.

2. Individual traits are inherited independently of one another.

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Chapter 8

Genetics & Gene Theory

Gene theory II - Phenotype may be affected by more than one gene and genes can change.

 The position of the gene on the chromosome is its locus (pl. loci).

1. Mutations: abrupt hereditary changes

Hugo de Vries, 1902, first used the term mutant

 most turned out to be just new allele combinations

helped to explain sources of variability in natural populations in Darwin's theory

2. Allele interactions

incomplete dominance: expression of heterozygote (Yy) is intermediate between the two homozygotes (YY and yy) (e.g. pink snapdragons)

 traits not always as clear cut a Mendel’s pea plants

codominance: the combined effect of two different alleles of a single gene

 heterozygote expresses both phenotypes simultaneously (e.g. blood type AB)

3. Gene interactions: interactions among alleles of *different* genes

polygenic inheritance: cumulative expression of the combined effects of many genes

 (e.g. traits such as size, height, weight, color, metabolic rate, behavior, etc.)

continuous variation: gradation of small differences in an individual trait affected by

 more than one gene (e.g. height distribution)

pleiotropy: a single gene having multiple effects on the phenotype (e.g. cartilage)

4. Genes and the environment

gene expression: expression of any gene is related to environmental factors

(e.g. light, nutrients, temperature, pH, salinity, etc.)

example: plants grown in the dark don’t turn green

5. Linkage and Crossing Over

genes assort independently if they are on different pairs of homologous chromosomes

alleles of two different genes on the *same* chromosome will not assort independently,

but they may recombine by crossing over

6. Sex-Linked traits

genes are carried on the sex chromosomes (e.g. color blindness, hemophilia)