

Reproduction

Cellular reproduction

Somatic

Cell cycle

Interphase (G<sub>1</sub>, S, G<sub>2</sub>)

Mitosis (separation of replicate chromatids in preparation for cytokinesis)

Spindle fibers, centromeres

Prophase, metaphase, anaphase, telophase

Ploidy of daughter cells is same as ploidy of parent cell.

Cancer

Normal cell activity

Contact inhibition, apoptosis, differentiation, etc.

Cancer cell activity

Abnormal nucleus, disorganized, metastasis, angiogenesis

Cancer treatment

Gametic (germ line)

Gametogenesis--spermatogenesis & oogenesis

Meiosis (segregation of homologous chromosomes into haploid gametes)

Meiosis I (reduction division)

Prophase I, metaphase I, anaphase I, telophase I

Ploidy is reduced from diploid to haploid.

Independent assortment of genes on different chromosomes

Meiosis II

Metaphase II, anaphase II, telophase II

Parent cells and daughter cells are haploid.

Organismal reproduction

Asexual

Cloning

Binary fission

Budding

Ameiotic parthenogenesis

Haplodiploidy

Meiotic parthenogenesis

Sexual--dioecy (separate sexes), monoecy (hermaphroditism)

Sexual life cycle

Meiosis, ovum, sperm, fertilization, zygote, embryo, development

Costs to individual

Half of all alleles thrown away during meiosis.

Half of offspring (males) can't produce eggs.

Advantage for population

Increased variability, so sexual populations can adapt to changes

Sex determination in *Drosophila*, mammals, birds, & reptiles

Maternal physiological investment

Ovipary, ovovivipary

Vivipary--example: placental mammals

## Genetics

### Genetic analysis (transmission genetics)

#### Mendelian genetics

Alleles, genes, genome, genotype, phenotype, dominance relations

Pea genes--plant height, seed color, seed shape

Monohybrid & dihybrid crosses, homozygous & heterozygous

P, F<sub>1</sub>, F<sub>2</sub>, Punnett square, genotypic & phenotypic ratios

Segregation & independent assortment

#### Chromosomes

Autosomal genes--autosomes have homologues

Sex-linked genes--homogametic (XX) & heterogametic (XY) sexes

Linked genes

#### Human inheritance

Pedigree analysis (male squares, female circles)

Autosomal recessive disorders--Tay-Sachs disease, cystic fibrosis

Autosomal dominant disorders--Huntington's chorea

X-linked recessive disorders--hemophilia

Polymorphism--PTC tasting, blood groups

Incomplete dominance--sickle-cell anemia

Sex-influenced traits

Codominance (A & B blood types)

Multiple alleles (ABO gene locus)

Genetic counseling

### Molecular genetics

#### DNA structure

Nucleotide--phosphate, deoxyribose, nitrogenous base

Double helix of 2 antiparallel strands

Phosphodiester backbones, complementarity

#### DNA function

Replication--Template strand, leading strand, lagging strand, Okazaki fragment

Enzymes: Helicase, RNA polymerase, DNA polymerase, DNA ligase

Transcription--synthesis of complementary RNA strand from gene in DNA

#### RNA structure

Single-stranded, ribose, uracil instead of thymine

#### RNA function--transcription, etc

#### Translation (protein synthesis)

Ribosome, ribosomal RNA, messenger RNA, transfer RNA, polypeptide

#### Causes & consequences of mutations

#### Gene regulation

Regulatory proteins, DNA binding sites, promoter, lactose operon in *E. coli*

#### Biotechnology--Cloning genes & organisms, genetic engineering

Recombinant DNA--complementarity & DNA-binding proteins, endonucleases

Splicing, vector, replication, amplification, clone, donor, recipient, PCR

Sources of genes to clone--genomic DNA, cDNA, synthesized oligonucleotides

Applications of genetic engineering

Research, protein synthesis, agriculture, medicine, forensics, sequencing

Ethical, legal, environmental, & social questions