SBI-3U1 **Genetics Unit Review – Major Concepts**

Chapter	Big Concept	Sub-concepts
4	Eukaryotic cells divide by mitosis/ cytokinesis.	• Cell division produces two genetically-identical cells from a mother cell. • Mitosis occurs in four phases. • Cytokinesis is different in animal cells and plant cells.
	Cell division is a small part of the cell cycle.	• Two stages of growth and preparation (G_1, G_2) and a stage of DNA replication (S) make up interphase.
	Somatic cells contain 23 homologous *pairs* of DNA (2 full sets).	• The homologs in each pair contain corresponding alleles for the same gene. • Each parent contributes one full set of DNA to the offspring.
	Meiosis produces haploid gametes.	• Meiosis occurs in two sets of divisions: ○ meiosis I (reduction division) and meiosis II • By the end of Meiosis I, the cells are already haploid (*n = 23 in humans*).

	Meiosis produces new combinations of genes.	• Genetic recombination occurs in two ways:
		  ○ Crossing over/synapsis (linked genes)
		  ○ Independent assortment (unlinked)
		• Gametes are genetically-distinct from one another.

	Errors can occur in meiosis.	• Errors can occur at the level of chromosomal structure, or chromosomal number (aneuploidy). • Aneuploidy is produced by non-disjunction at either anaphase. • Offspring produced by aneuploid gametes will have noticeable characteristics.
	Reproductive technologies are employed in agriculture and in humans.	• Selective breeding (traditional) • Artificial insemination, IVF and embryo transfer (modern)
	Genes can be cloned.	• Possibilities: gene cloning, tissue cloning (therapeutic), organism cloning (reproductive) • SCNT is utilized in both therapeutic and reproductive cloning; has associated ethical concerns.
	Transgenic organisms have DNA from *other species* inserted into their genomes.	• Used to increase agricultural/economic productivity. • Associated ethical concerns
5	Alleles for traits can be dominant or recessive.	• Dominant alleles mask the presence of recessive alleles. • The phenotype does not necessarily reflect the genotype (in the case of a hybrid).
	Genetic crosses are an experimental method of studying inheritance.	• Mendel's experiments and inferences • Mendel's Laws: Segregation and Independent Assortment. • Predictions of Mendel's Laws (predictable monohybrid and dihybrid ratios). • <u>Terminology</u>: Parental, F_1 (first filial), F_2, cross, test cross, monohybrid, dihybrid, heterozygous, homozygous
	Punnett squares can be used to analyze genetic crosses.	• <u>All</u> genetic crosses (not just hybrid) can be analyzed using Punnett squares. • They can be used to make predictions about offspring genotypes/phenotypes, and inferences about parental genotypes.

	Many human traits follow simple Mendelian patterns of inheritance.	• Not possible to study human inheritance experimentally. • Pedigree analysis is used. ○ *Be familiar with the symbols*
	Different patterns of inheritance are reflected in pedigrees.	• Autosomal vs. Sex-linked • Dominant vs. Recessive • Sometimes more than one pattern of inheritance may be possible, based on a pedigree
6	Some genes follow Mendelian Laws, but the relationship between genotype and phenotype is not straightforward	• Incomplete dominance – One trait is dominant over the other, but cannot completely mask the recessive trait. • Co-dominance – Both traits are <u>fully</u> expressed if present. • Multiple allelism ○ Human ABO blood groups demonstrate complete dominance, co-dominance, and multiple allelism. Know the genotypes and phenotypes. • Pleiotropy – One genotype can have a spectrum of <u>multiple</u> effects in the phenotype.
	Polygenic inheritance occurs when multiple loci contribute to the phenotype.	• The phenotype is the result of the additive effects of all present alleles. • Polygenic traits exhibit *continuous* variation in a population (vs. discrete categories) • Also called *quantitative* traits. • Examples: Height, skin colour.
	Complex inheritance occurs when epistatic interactions exist between loci.	• In epistasis, the particular alleles present at one locus have an effect on the expression of the alleles at a second locus.
	Environmental factors during development also play a role in gene expression.	• Genetic determinism is rarely a rule. • Environmental influence can affect whether a phenotype is expressed (penetrance), or the degree of expression (expressivity).
	Linked genes are genes that tend to be inherited together.	• Empirical observation: They do not follow the law of independent assortment. ○ Parental combinations of alleles are seen more frequently in the F_2 generation. • Chromosomal basis: Linked genes are located on the same chromosome.

	Sex-linked genes are located on the sex chromosomes (X and Y)	• Sex-linked genes are located in the unique regions of the sex chromosomes (not the pseudo-autosomal regions - PAR)
		• Sex of the individual influences the expression of sex-linked traits.
		  ○ Males are heterogametic (XY)– they are more likely to display X-linked recessive traits
		  ○ Males cannot pass on X-linked recessive traits to their sons, but all daughters will possess at least one recessive allele.
		• Some human traits are sex-linked. Their inheritance can be observed in pedigrees.
		• In females, one X chromosome in each cell becomes randomly inactivated early in development.

Chapter 4
Self assessment Pg. 198 #1-20

Chapter 5
Chapter review Pg. 235 #1-26

Chapter 6
Chapter review Pg. 273 #1-27 (skip 8)