

MCDB 1041-Fundamentals of Human Genetics (non majors): Learning Goals (with syllabus topics)

You should be able to:

Cells

Name the different domains of life, and know about relative sizes of cells

Recognize the components of a cell and describe why each is necessary for the function of a cell

Briefly describe why organelles are present and what their general functions are, including the contents of the nucleus

Mitosis

Describe the basic principle of mitosis (why do cells undergo mitosis?).

Diagram how an exact replica of the genetic material is made, including the numbers of chromosomes present at each phase of mitosis.

Distinguish between chromosome, replicated chromosomes, and sister chromatids.

Propose a reason why cells need to go through a “cell cycle”.

Meiosis

Describe how gametes are made, and what kinds of cells they arise from.

Compare the two phases of meiosis, and justify why the chromosomes separate differently in each phase.

Compare mitosis to meiosis: what are the differences and similarities?

Justify the importance of crossing over.

Predict the possible outcomes of various mistakes in meiosis.

Gamete maturation and embryonic development

Define what stem cells are, and be able to defend their importance in the human body.

Compare how the maturation of spermatocytes and oocytes.

Appreciate the amazing events of fertilization and human embryonic development.

Transmission of Genes – Segregation and Independent Assortment

Justify how Mendel arrived at his laws of inheritance

Define and use correctly the terms: homozygous, heterozygous, dominant and recessive

Describe the basic principles of inheritance (segregation and independent assortment)

Calculate the probability of inheritance of particular genes or traits based on probability

Distinguish between “independent” and “dependent” events

Modes of inheritance and pedigrees

Construct a pedigree from given information

Calculate the likelihood of a genetic event based on a pedigree

Determine which mode of inheritance is most likely based on information in a pedigree

Variations and Extensions of Mendel's laws

Explain how having multiple alleles for a single gene results in multiple distinguishable traits (rather than two for two alleles).

Explain how alleles can have different relationships besides simple recessiveness or dominance.

Explain several possible reasons why a given genotype does not always result in the same phenotype.

Compare inheritance of the mitochondrial genome with the nuclear genome.

Contrast the inheritance of linked genes with unlinked genes.

Sexual development and dosage compensation

Distinguish how "phenotypic" sex is different from "gonadal" sex

Explain how the outward sex characteristics can be mismatched with genetic sex (the sex chromosomes)

Describe what dosage compensation is, and the basic mechanism for how it works in humans.

Compare the impact of dosage compensation on individuals with sex chromosomal abnormalities.

Molecular Genetics

Explain the "central dogma" of genetic information transfer

Describe the relationship between chromosomes, genes and DNA

Distinguish between the theories for how DNA replication might work, and explain how it does work

Draw the process of transcription and explain its utility

Diagram the processing of mRNA transcripts before translation and explain why they happen

Demonstrate how we know the "code" is non-overlapping and redundant.

Interpret how mutations might affect protein structure

Mutations

Recognize different kinds of mutations (frameshift, insertions, deletions, point mutations), and predict their effect on amino acid sequence and protein structure.

Predict the likelihood of a region of DNA incurring a mutation

Give examples of how DNA can be mutated

Explain why most of us are relatively normal despite the fact that mutations occur in our DNA

Applications of DNA technology

Describe the basic idea of PCR, and how/why it is used.

Explain how gel electrophoresis works, and interpret data from a gel.

Recognize palindromic restriction enzyme sites, and explain why restriction enzymes might be used.

Explain the significance of variable regions in DNA

Interpret gel electrophoresis data, and explain how gels can be used

Explain what an STR is, and HOW STRs can be used in DNA fingerprint analysis

Transgenics and Cloning

Design a transgenic animal, where a protein of interest is specifically produced in some

cells.

Explain how cloning can be done, and why one might want to clone an animal.

Describe the differences between a clone and the organism it was cloned from.

Justify reasons for using therapeutic cloning vs. reproductive cloning.

Gene Therapy

Explain the relevance of gene therapy

Compare different kinds of gene therapies

Justify reasons for continuing gene therapy research despite setbacks

Cancer

Describe how cancer begins and how it spreads.

Connect the cell cycle to how cancer initiates.

Apply the principles of genetics to cancer (what genes are mutated, what else is wrong with cancer cells, etc.).

Analyze the possible efficacy of cancer treatments.