Give these questions to someone to quiz you on each topic.

Here are the **questions and answers** together for each topic:

1. Division and Differentiation in Human Cells
    1. **What process do somatic cells undergo to divide?**
       Mitosis
    2. **What is the process by which germline stem cells produce more germline cells?**
       Mitosis and meiosis
    3. **What process produces haploid gametes?**
       Meiosis
    4. **What is a somatic cell?**
       Any cell in the body except reproductive cells
    5. **What is a germline cell?**
       Gametes (sperm and ova) and the cells that divide to form gametes
    6. **How many chromosomes do diploid cells contain?**
       46 chromosomes (23 pairs)
    7. **How many chromosomes are present in a haploid cell?**
       23 chromosomes
    8. **What are pluripotent stem cells?**
       Stem cells that can differentiate into any type of cell
    9. **What are multipotent stem cells?**
       Stem cells that can differentiate into all cell types in a specific tissue
    10. **What role do tissue stem cells play in the body?**
        Growth, repair, and renewal of cells in the tissue
    11. **What is a tumor?**
        A mass of abnormal cells caused by excessive cell division
    12. **How do cancer cells differ from normal cells in their growth?**
        Cancer cells do not respond to regulatory signals and divide uncontrollably

2. Structure and Replication of DNA
    1. **What are the three main components of a DNA nucleotide?**
       Deoxyribose sugar, phosphate group, nitrogenous base
    2. **Which base pairs with adenine in DNA?**
       Thymine
    3. **Which base pairs with cytosine in DNA?**
       Guanine
    4. **What is the shape of a DNA molecule?**
       Double helix
    5. **What type of bond holds the nitrogenous bases together in DNA?**
       Hydrogen bonds
    6. **How many strands are in a DNA molecule?**
       Two strands
    7. **What enzyme adds nucleotides during DNA replication?**
       DNA polymerase
    8. **What role do primers play in DNA replication?**
       They provide a starting point for DNA synthesis by binding to the template strand
    9. **What is the process of PCR used for?**
       Amplifying DNA in the laboratory
    10. **At what temperature are DNA strands separated during PCR?**
        92–98°C
    11. **What is the role of DNA ligase in replication?**
        Joins fragments of DNA together
    12. **What happens to the sugar-phosphate backbone during replication?**
        It is maintained by covalent bonds between the sugar and phosphate groups

3. Gene Expression
    1. **What is gene expression?**
       The process by which a gene is transcribed into RNA and then translated into a protein
    2. **What is mRNA, and where is it made?**
       Messenger RNA, made in the nucleus
    3. **What is the function of tRNA in protein synthesis?**
       Transfer RNA carries specific amino acids to the ribosome during protein synthesis
    4. **What is the role of rRNA in the cell?**
       It helps form the ribosome, which is the site of protein synthesis
    5. **What is a codon?**
       A triplet of bases on mRNA that codes for a specific amino acid
    6. **What is an anticodon?**
       A triplet of bases on tRNA that pairs with a complementary codon on mRNA
    7. **What are introns?**
       Non-coding regions of the primary mRNA transcript
    8. **What are exons?**
       Coding regions of the primary mRNA transcript
    9. **What is the process of transcription?**
       The process of copying a DNA sequence into mRNA
    10. **What is the process of translation?**
        The process of assembling a protein using the information in mRNA
    11. **How is the primary mRNA transcript formed?**
        By RNA polymerase synthesizing mRNA from RNA nucleotides
    12. **What is alternative RNA splicing?**
        The process by which different mRNA molecules are produced from the same primary transcript by including or excluding specific exons

4. Mutations
    1. **What is a mutation?**
       A change in the DNA sequence
    2. **What is a missense mutation?**
       A single nucleotide change that results in the substitution of one amino acid for another
    3. **What is a nonsense mutation?**
       A mutation that introduces a premature stop codon
    4. **What is a splice-site mutation?**
       A mutation at a site where splicing of introns and exons occurs
    5. **What is a frame-shift mutation?**
       A mutation that shifts the reading frame of the genetic code
    6. **What is a chromosome mutation?**
       A change in the structure of a chromosome
    7. **What is a duplication mutation?**
       A section of a chromosome is duplicated
    8. **What happens in a deletion mutation?**
       A section of a chromosome is removed
    9. **What happens in an inversion mutation?**
       A section of a chromosome is reversed
    10. **What is a translocation mutation?**
        A section of a chromosome is moved to another chromosome
    11. **How can mutations affect protein synthesis?**
        Mutations can result in the production of a non-functional or altered protein
    12. **What are the three main types of nucleotide substitutions?**
        Missense, nonsense, and splice-site mutations

5. Human Genomics

1. **What is a genome?**
   The entire hereditary information encoded in an organism's DNA
2. **What is genomic sequencing?**
   Determining the sequence of nucleotide bases in DNA
3. **What is the role of bioinformatics in genomic research?**
   To analyze and interpret large sets of genetic data
4. **What is pharmacogenetics?**
   The study of how genetic variation influences an individual's response to drugs
5. **What is personalized medicine?**
   Tailoring medical treatment to the individual based on their genome
6. **How can genomic sequencing predict disease risk?**
   By identifying gene variants associated with disease risk
7. **What is the importance of non-coding sequences in the genome?**
   Sequences of DNA that do not code for proteins but may regulate gene expression
8. **How can computer programs help in identifying base sequences?**
   To find sequences similar to known genes
9. **What can the analysis of a person's genome help to determine?**
   Whether they are likely to develop certain genetic diseases
10. **What is the use of sequence data in medical research?**
    Understanding the genetic basis of diseases and improving drug development

6. Metabolic Pathways
   1. **What are metabolic pathways?**
      A series of enzyme-controlled reactions in cells
   2. **What is an anabolic reaction?**
      A reaction that builds larger molecules from smaller ones and requires energy
   3. **What is a catabolic reaction?**
      A reaction that breaks down large molecules into smaller ones and releases energy
   4. **What is the function of enzymes in metabolic pathways?**
      To catalyze reactions by lowering the activation energy required
   5. **What is induced fit in enzyme activity?**
      When an enzyme's active site changes shape to fit the substrate more tightly
   6. **What is competitive inhibition?**
      When an inhibitor binds to the enzyme's active site, preventing the substrate from binding
   7. **What is non-competitive inhibition?**
      When an inhibitor binds away from the active site but changes the enzyme's shape, preventing the substrate from binding
   8. **What is the purpose of feedback inhibition?**
      To regulate the production of a product by inhibiting an earlier step in the pathway
   9. **How do reversible reactions occur in metabolic pathways?**
      Reactions that can proceed in both directions depending on the concentrations of reactants and products
   10. **What is the role of substrates in enzyme reactions?**
       They are the molecules that enzymes act on to form products
   11. **What is the effect of product concentration on enzyme reactions?**
       An increase in product concentration can slow down or reverse the reaction
   12. **What is the significance of the active site in enzyme function?**
       It binds to the substrate and lowers the activation energy needed for the reaction to occur

7. Cellular Respiration
   1. **What is the first stage of cellular respiration?**
      Glycolysis
   2. **What is glycolysis?**
      The breakdown of glucose into pyruvate

3. **What happens during the energy investment phase of glycolysis?**
   Glucose is phosphorylated using ATP
4. **What happens during the energy pay-off phase of glycolysis?**
   ATP is generated, and there is a net gain of ATP
5. **What is the role of acetyl coenzyme A in respiration?**
   It combines with oxaloacetate to form citrate in the citric acid cycle
6. **What is the citric acid cycle?**
   A series of reactions that generate ATP and release carbon dioxide
7. **Where does the citric acid cycle take place?**
   In the matrix of the mitochondria
8. **What do dehydrogenase enzymes do?**
   They remove hydrogen ions and electrons and pass them to NAD to form NADH
9. **What happens in the electron transport chain?**
   Electrons are passed along a series of carrier proteins, releasing energy
10. **How is ATP synthesized in cellular respiration?**
    Energy is used to pump hydrogen ions across the mitochondrial membrane, which drives ATP production
11. **What is the final electron acceptor in the electron transport chain?**
    Oxygen
12. **What is the role of oxygen in cellular respiration?**
    It combines with hydrogen ions and electrons to form water

8. Energy Systems in Muscle Cells
   1. **What happens to pyruvate in the absence of oxygen?**
      It is converted into lactate
   2. **What is lactate metabolism?**
      The conversion of pyruvate to lactate during anaerobic respiration
   3. **What causes muscle fatigue?**
      Accumulation of lactate in the muscles
   4. **What is an oxygen debt?**
      The amount of oxygen required after exercise to convert lactate back to pyruvate
   5. **How is lactate converted back to pyruvate?**
      Through the process of respiration, when oxygen is available
   6. **What are slow-twitch muscle fibers?**
      Muscle fibers that contract slowly and sustain contractions for a long time
   7. **What are fast-twitch muscle fibers?**
      Muscle fibers that contract quickly but tire easily
   8. **Which type of muscle fibers are used for endurance activities?**
      Slow-twitch muscle fibers
   9. **Which type of muscle fibers are used for short bursts of energy?**
      Fast-twitch muscle fibers
   10. **How do slow-twitch fibers generate ATP?**
       Through aerobic respiration, using oxygen
   11. **How do fast-twitch fibers generate ATP?**
       Through glycolysis, without using oxygen
   12. **What is the main fuel source for slow-twitch and fast-twitch muscle fibers?**
       Slow-twitch: fats; fast-twitch: glycogen