HUDSONALPHA INSTITUTE FOR BIOTECHNOLOGY

MISSISSIPPI BIOLOGY ALIGNMENT RESOURCES

■ Text Resources ■ Digital Resources ■ Classroom Kits (Available from Carolina Biological)

BIO. 1 CELLS AS A SYSTEM

BIO.1B Students will analyze the structure and function of the macromolecules that make up cells.

BIO.1B.1 Develop and use models to compare and contrast the structure and function of carbohydrates, lipids, proteins, and nucleic acids (DNA and RNA) in organisms.

BIO.1B.2 Design and conduct an experiment to determine how enzymes react to given various environmental conditions (i.e., pH, temperature, and concentration). Analyze, interpret, graph, and present data to explain how those changing conditions affect the enzyme activity and the rate of the reactions that take place in biological organisms.

BIO.1C.2 Investigate to compare and contrast prokaryotic cells and eukaryotic cells, and plant, animal, and fungal cells.

BIO.1E Students will develop and use models to explain the role of the cell cycle during growth, development, and maintenance in multicellular organisms.

BIO.1E.1 Construct models to explain how the processes of cell division and cell differentiation produce and maintain complex multicellular organisms.

BIO.1E.2 Identify and describe the changes that occur in a cell during replication. Explore problems that might occur if the cell does not progress through the cycle correctly (cancer).

BIO.1E.3 Relate the processes of cellular reproduction to asexual reproduction in simple organisms (i.e., budding, vegetative propagation, regeneration, binary fission). Explain why the DNA of the daughter cells is the same as the parent cell.

BIO.1E.4 Enrichment: Use an engineering design process to investigate the role of stem cells in regeneration and asexual reproduction, then develop applications of stem cell research to solve human medical conditions.

- **Guidebook:** Foundational Concepts and Applications: RNA and Protein Analysis, Recombinant DNA and Genetic Engineering, Synthetic Biology, Pharmacogenomics
- **Guidebook:** Foundational Concepts and Applications: Stem Cells
- **Enzymes to Go!™** to purchase, contact edoutreach@hudsonalpha.org
- **iCell®**

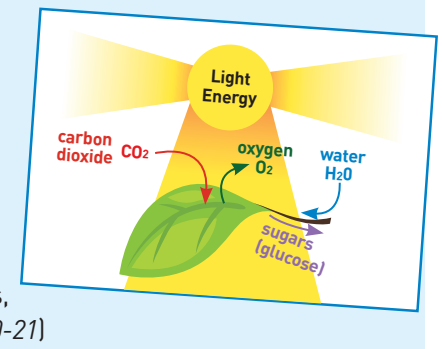
- **Focus on Cancer video** www.youtube.com/watch?v=RVEd5Sx01Gs
- **Collecting Cancer-Causing Changes®**

- **Chromosocks®** Chromosock Mitosis Protocol hudsonalpha.org/compendium-resources/

BIO. 2 Energy Transfer

BIO.2 Students will explain that cells transform energy through the processes of photosynthesis and cellular respiration to drive cellular functions.

BIO.2.4 Conduct scientific investigations or computer simulations to compare aerobic and anaerobic cellular respiration in plants and animals, using real world examples.



- **Guidebook:** 2018/19 Guidebook: Genetics, Plant Growth and Photosynthesis *(pgs. 20-21)*
- **"Biobeads: Modeling Cell Processes"** (teacher-developed lesson)
- **"Alien Gases"** (teacher-developed lesson) https://hudsonalpha.org/compendium-resources/

BIO. 3 Reproduction and Heredity

BIO.3A Students will develop and use models to explain the role of meiosis in the production of haploid gametes required for sexual reproduction.

BIO.3A.1 Model sex cell formation (meiosis) and combination (fertilization) to demonstrate the maintenance of chromosome number through each generation in sexually reproducing populations. Explain why the DNA of the daughter cells is different from the DNA of the parent cell.

BIO.3A.2 Compare and contrast mitosis and meiosis in terms of reproduction.

BIO.3A.3 Investigate chromosomal abnormalities (e.g., Down syndrome, Turner's syndrome, and Klinefelter syndrome) that might arise from errors in meiosis (nondisjunction) and how these abnormalities are identified (karyotypes).

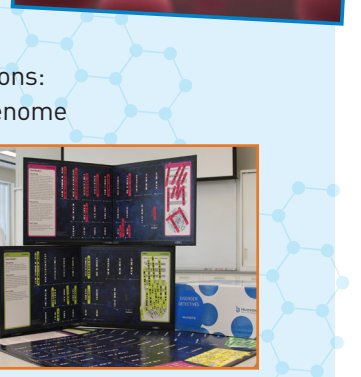
BIO.3B Students will analyze and interpret data collected from probability calculations to explain the variation of expressed traits within a population.

BIO.3B.1 Demonstrate Mendel's law of dominance and segregation using mathematics to predict phenotypic and genotypic ratios by constructing Punnett squares with both homozygous and heterozygous allele pairs.

BIO.3B.2 Illustrate Mendel's law of independent assortment using Punnett squares and/or the product rule of probability to analyze monohybrid crosses.

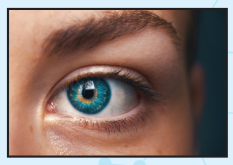
BIO.3B.3 Investigate traits that follow non-Mendelian inheritance patterns (e.g., incomplete dominance, codominance, multiple alleles in human blood types, and sex-linkage).

BIO.3B.4 Analyze and interpret data (e.g., pedigrees, family, and population studies) regarding Mendelian and complex genetic traits (e.g., sickle-cell anemia, cystic fibrosis, muscular dystrophy, color-blindness, and hemophilia) to determine patterns of inheritance and disease risk.



- **Chromosocks®**
- **Meiosis Modeling Mendel's Laws®**
- **Meiosis Video** https://www.youtube.com/watch?v=9sJU9-ellrs
- **Chromosocks®**
- **Guidebook:** Foundational Concepts and Applications: Diagnosing Chromosome Disorders, Personal Genome Analysis, Noninvasive Prenatal Testing
- **Disorder Detectives®**

- **Chromosocks**
- **Modeling Mendel's Laws®**



- **Guidebook:** Foundational Concepts and Applications: Genetics of Eye Color
- **Modeling Mendel's Laws®**

- **Touching Triton®**
- **HG Helix®**
- **Shareable Science Blog:** "What do the genetic pieces of ADHD look like?"
- **Guidebook:** Foundational Concepts and Applications: Diagnosing Chromosome Disorders, Personal Genome Analysis, Noninvasive Prenatal Testing
- **Chromosock Meiosis®**
- **Modeling Mendel's Laws®**
- **HNPCC: Investigating Hereditary Cancer®**
- **Collecting Cancer-Causing Changes®**
- **Making Sense of Uncertainty®**

- **Touching Triton ®**
- **HG Helix ®**
- **Shareable Science Blog:** "What do the genetic pieces of ADHD look like?"

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BIO. 3 Reproduction and Heredity

BIO.3C Students will construct an explanation based on evidence to describe how the structure and nucleotide base sequence of DNA determines the structure of proteins or RNA that carry out essential functions of life.

BIO.3C.1 Develop and use models to explain the relationship between DNA, genes, and chromosomes in coding the instructions for the traits transferred from parent to offspring.

BIO.3C.2 Evaluate the mechanisms of transcription and translation in protein synthesis.

BIO.3C.3 Use models to predict how various changes in the nucleotide sequence (e.g., point mutations, deletions, and additions) will affect the resulting protein product and the subsequent inherited trait.

BIO.3C.4 Research and identify how DNA technology benefits society. Engage in scientific argument from evidence over the ethical issues surrounding the use of DNA technology (e.g., cloning, transgenic organisms, stem cell research, and the Human Genome Project, gel electrophoresis).

BIO.3C.5 Enrichment: Investigate current biotechnological applications in the study of the genome (e.g., transcriptome, proteome, individualized sequencing, and individualized gene therapy

- **Guidebook:** Foundational Concepts and Applications: Copy Number Variation, Identifying Genetic Influence on Disease, Infectious Disease, Personal Genome Analysis, Genetics of Eye Color, Studying the Genome to Understand the Sequence

- **Genes & ConSEQUENCES®**
- **Guidebook:** Foundational Concepts and Applications: DNA Sequencing, RNA and Protein Analyses, Bioinformatics, Recombinant DNA and Genetic Engineering, Synthetic Biology, Therapeutic Approaches: Gene Therapy, Personal Genome Analysis, Genome Editing

- **HNPCC: Investigating Hereditary Cancer®**
- **Genes & ConSEQUENCES®**
- **Progress of Science:** Biotechnology Timeline™
- **Shareable Science Blog:** "Scientists showcase hachimoji, an expanded genetic language"
- **Guidebook:** Foundational Concepts and Applications: DNA Sequencing, RNA and Protein Analyses, Bioinformatics, Recombinant DNA and Genetic Engineering, Synthetic Biology, Therapeutic Approaches: Gene Therapy,

- **HNPCC: Investigating Hereditary Cancer®**
- **Genes & ConSEQUENCES®**
- **Collecting Cancer-Causing Changes®**
- **Exploring and Understanding the ENCODE Project** Large Scale Genome Sequencing[4]
- **Guidebook:** Foundational Concepts and Applications: Recombinant DNA and Genetic Engineering, Studying the Genome to Understand the Sequence, Therapeutic Approaches: Gene Therapy and RNAi, Stem Cells, Synthetic Biology, Genome Editing, Criminal Justice and Forensics
- **Shareable Science Blog:**
  "The Ethics of DNA Testing: Ancestry and Crime"
  "Understanding RNAi: First-of-its-kind Genetic Treatment Approved"
  "Gene Therapies bring Genomic Research to Patients in Life-Changing Ways"
  and more
- **Understanding ENCODE video** www.youtube.com/watch?v=yjpW30z-SB8
- **Progress of Science:** Biotechnology Timeline™
- **Guidebook:** Foundational Concepts and Applications: DNA Sequencing, RNA and Protein Analyses, Bioinformatics, Recombinant DNA and Genetic Engineering, Synthetic Biology, Therapeutic Approaches: Gene Therapy

- **Progress of Science:** Biotechnology Timeline™
  "History of DNA Technology"
  https://hudsonalpha.org/compendium-resources/

BIO. 4 Adaptions and Evolution

BIO.4.2 Evaluate empirical evidence of common ancestry and biological evolution, including comparative anatomy (e.g., homologous structures and embryological similarities), fossil record, molecular/biochemical similarities (e.g., gene and protein homology), and biogeographic distribution.

BIO.4.4 Design models and use simulations to investigate the interaction between changing environments and genetic variation in natural selection leading to adaptations in populations and differential success of populations.

BIO.4.7 Enrichment: Construct explanations for how various disease agents (bacteria, viruses, chemicals) can influence natural selection.

- **Guidebook:** Foundational Concepts and Applications: Comparative Genomics, Studying the Genome to Understand the Sequence
- **Guidebook:** 2017-2018 Guidebook: Types of Genetic Testing *(pgs. 20-21)*
- **Shareable Science Blog:** "Human Genome Diversity Project"
  "Genetic Ancestry: What tests can really tell us"

- **Guidebook:** Foundational Concepts and Applications: Comparative Genomics, Infectious disease, Studying the Genome to Understand the Sequence
- **Agricultural Genomics**
  https://hudsonalpha.org/wp-content/uploads/2014/04/Agricultural-Genomics.pdf

- **Guidebook:** Foundational Concepts and Applications: Comparative Genomics, Infectious disease, Identifying Genetic Influence on Disease