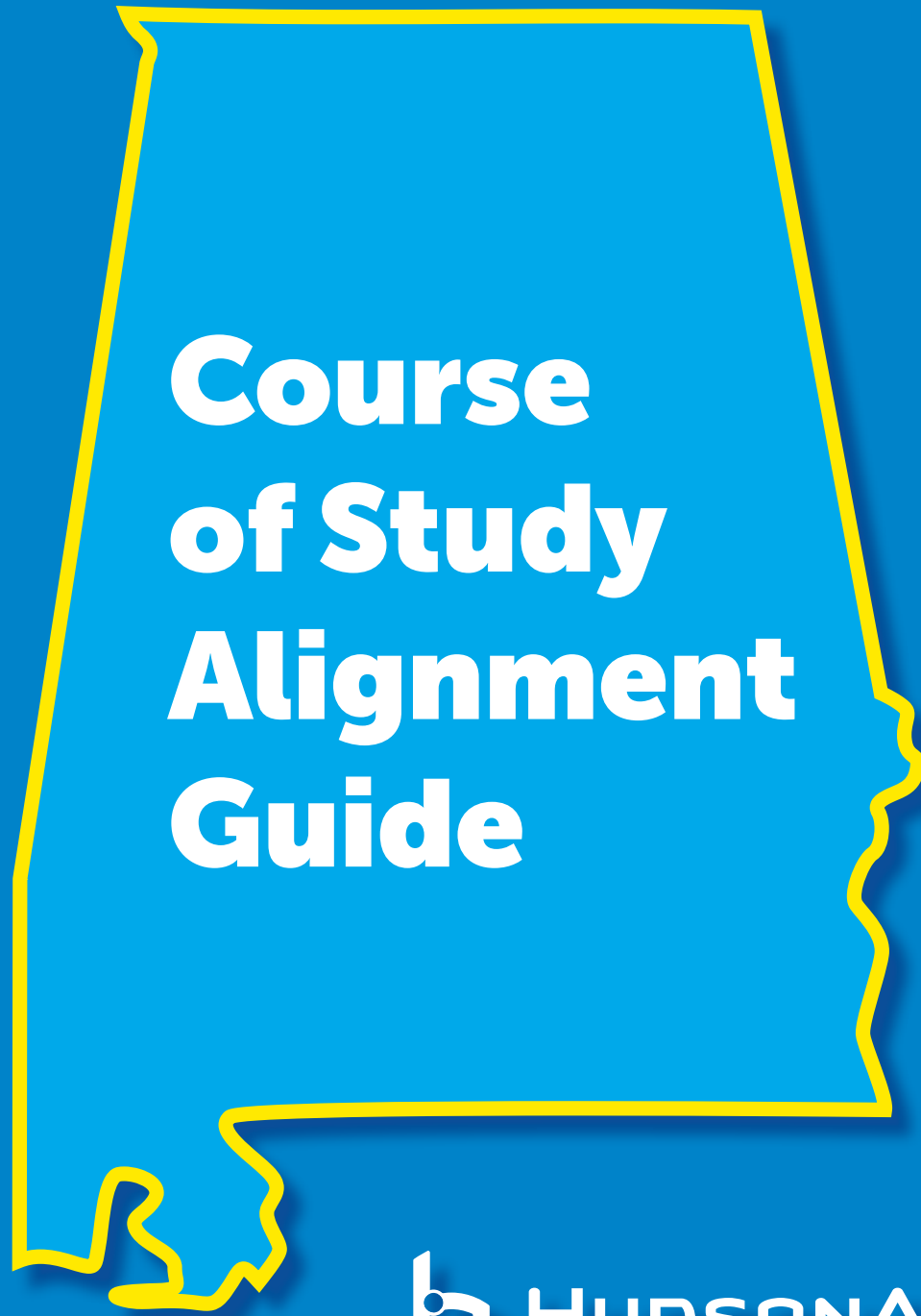


# Alabama



**HUDSONALPHA**  
INSTITUTE FOR BIOTECHNOLOGY

## COURSE OF STUDY CONNECTED TO GUIDEBOOK TOPICS

Course	Objective and Applicable Subheading	Linking Scientific Concept
Biology	<b>1</b> Use models to compare and contrast how the structural characteristics of carbohydrates, nucleic acids, proteins and lipids define their function in organisms.	DNA Sequencing, RNA and Protein Analyses, Recombinant DNA and Genetic Engineering, Synthetic Biology, Pharmacogenomics
	<b>2</b> Obtain, evaluate and communicate information to describe the function and diversity of organelles and structures in various types of cells [e.g., muscle cells having a large amount of mitochondria, plasmids in bacteria, chloroplasts in plant cells].	See HudsonAlpha iCell® (pg. 56) RNA and Protein Analysis, Gene Therapy and RNAi, Stem Cells
	<b>3</b> Formulate an evidence-based explanation regarding how the composition of deoxyribonucleic acid (DNA) determines the structural organization of proteins.	DNA Sequencing, RNA and Protein Analyses, Bioinformatics, Application, Recombinant DNA and Genetic Engineering, Synthetic Biology, Therapeutic Approaches: Gene Therapy, Copy Number Variation, Personal Genome Analysis, Genome Editing
	<b>3a</b> Obtain and evaluate experiments of major scientists and communicate their contributions to the development of the structure of DNA and to the development of the central dogma of molecular biology.	DNA Sequencing, Bioinformatics, Genetic Information Nondiscrimination Act, Personalized Medicine, Pharmacogenomics, Genome Editing. See also The Progress of Science Timeline (pg. 56)
	<b>3b</b> Obtain, evaluate, and communicate information that explains how advancements in genetic technology [e.g., Human Genome Project, Encyclopedia of DNA Elements [ENCODE] project, 1000 Genomes Project] have contributed to the understanding as to how a genetic change at the DNA level may affect proteins and, in turn, influence the appearance of traits.	DNA Sequencing, RNA and Protein Analyses, Bioinformatics, Copy Number Variation, Genetics of Eye Color, Personalized Medicine, Personal Genome Analysis, Studying the Genome to Understand the Sequence, Synthetic Biology, Therapeutic Approaches: RNAi, Genome Editing
	<b>3c</b> Obtain information to identify errors that occur during DNA replication [e.g., deletion, insertion, translocation, substitution, inversion, frame-shift, point mutations].	Diagnosing Chromosome Disorders, Personal Genome Analysis, Noninvasive Prenatal Diagnosis
	<b>4</b> Develop and use models to explain the role of the cell cycle during growth and maintenance in multicellular organisms [e.g., normal growth and/or uncontrolled growth resulting in tumors].	Cancer, Stem Cells, Diagnosing Chromosome Disorders
	<b>10</b> Construct an explanation and design a real-world solution to address changing conditions and ecological succession caused by density-dependent and/or density-independent factors.	Agriculture - Sequencing Plant Genomes for Food and Bioenergy Needs, Genetically Modified Crops (biofuels and GM crops may play in a role in student developed real world solutions to ecological problems)
	<b>11</b> Analyze and interpret data collected from probability calculations to explain the variation of expressed traits within a population.	Copy Number Variation, Criminal Justice and Forensics, Epigenetics, Genetics of Eye Color, Noninvasive Prenatal Diagnosis, Therapeutic Approaches: Gene Therapy and RNAi, Noninvasive Prenatal Diagnosis, Diagnosing Chromosome Disorders, Epigenetics
	<b>11a</b> Use mathematics and computation to predict phenotypic and genotypic ratios and percentages by constructing Punnett squares, including using both homozygous and heterozygous allele pairs.	Genetics of Eye Color, Agriculture, Criminal Justice and Forensics, Identifying Genetic Influence on Disease, Epigenetics
	<b>11b</b> Develop and use models to demonstrate co-dominance, incomplete dominance and Mendel's laws of segregation and independent assortment.	Genetics of Eye Color, Diagnosing Chromosome Disorders, Identifying Genetic Influence on Disease, Epigenetics

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<b>Biology</b>	<b>11c</b> Analyze and interpret data (e.g., pedigree charts, family and population studies) regarding Mendelian and complex genetic disorders (e.g., sickle-cell anemia, cystic fibrosis, Type 2 diabetes) to determine patterns of genetic inheritance and disease risks from both genetic and environmental factors.	Copy Number Variation, Criminal Justice and Forensics, Genetic Information Nondiscrimination Act, Identifying Genetic Influence on Disease, Infectious Disease, Personal Genome Analysis, Personalized Medicine, Pharmacogenomics, Epigenetics, Genetics of Eye Color, Studying the Genome to Understand the Sequence
	<b>12</b> Develop and use a model to analyze the structure of chromosomes and how new genetic combinations occur through the process of meiosis.	Diagnosing Chromosome Disorders, Epigenetics, Noninvasive Prenatal Diagnosis
	<b>12a</b> Analyze data to draw conclusions about genetic disorders caused by errors in meiosis (e.g., Down syndrome, Turner syndrome).	Diagnosing Chromosome Disorders, Non-invasive Prenatal Diagnosis, Personal Genome Analysis, Therapeutic Approaches: Gene Therapy and RNAi, Copy Number Variation, Personalized Medicine, Pharmacogenomics
	<b>13a</b> Engage in argument to justify the grouping of viruses in a category separate from living things.	Infectious Disease
	<b>14</b> Analyze and interpret data to evaluate adaptations resulting from natural and artificial selection that may cause changes in populations over time (e.g., antibiotic-resistant bacteria, beak types, peppered moths, pest-resistant crops).	Comparative Genomics, Infectious Disease
	<b>15</b> Engage in argument from evidence (e.g., mathematical models such as distribution graphs) to explain how the diversity of organisms is affected by overpopulation of species, variation due to genetic mutations, and competition for limited resources.	Comparative Genomics
	<b>16</b> Analyze scientific evidence (e.g., DNA, fossil records, cladograms, biogeography) to support hypotheses of common ancestry and biological evolution.	Comparative Genomics, Studying the Genome to Understand the Sequence
<b>Anatomy and Physiology</b>	<b>3a</b> Analyze the effects of pathological conditions (e.g. burns, skin cancer, bacterial and viral infections, chemical dermatitis) to determine the body's attempt to maintain homeostasis.	Cancer, Infectious Disease, Diagnosing Chromosome Disorders, Identifying Genetic Influence on Disease, Studying the Genome to Understand the Sequence
	<b>6a</b> Use scientific evidence to evaluate the effects of pathology on the nervous system (e.g., Parkinson disease, Alzheimer disease, cerebral palsy, head trauma) and argue possible prevention and treatment options.	Personal Genome Analysis, Personalized Medicine, Identifying Genetic Influence on Disease, Pharmacogenomics
	<b>6b</b> Design a medication to treat a disorder associated with neurotransmission, including mode of entry into the body, form of medication, and desired effects.	Personalized Medicine, Identifying Genetic Influence on Disease, Pharmacogenomics
	<b>9a</b> Engage in argument from evidence describing how environmental (e.g., cigarette smoke, polluted air) and genetic factors may affect the respiratory system, possibly leading to pathological conditions (e.g., cystic fibrosis).	Cancer, Personal Genome Analysis, Identifying Genetic Influence on Disease, Personalized Medicine, Studying the Genome to Understand the Sequence

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Environmental Science	<p><b>1</b> Investigate and analyze the use of nonrenewable energy source (e.g., fossil fuels, nuclear, natural gas) and renewable energy sources (e.g., solar, wind, hydroelectric, geothermal) and propose solutions for their impact on the environment.</p>	Agriculture: Sequencing Plant Genomes for Food and Bioenergy Needs
	<p><b>6</b> Obtain, evaluate and communicate information to describe how human activity may affect biodiversity and genetic variation of organisms, including threatened and endangered species.</p>	Comparative Genomics, Recombinant DNA and Genetic Engineering, Agriculture
<p><b>AP Biology</b></p> <p><b>Big Idea 1 Evolution</b></p>	<p><b><i>The process of evolution drives the diversity and unity of life</i></b></p> <p>Enduring Understanding 1.A. Change in the genetic make-up of a population over time is evolution.</p> <p>Enduring Understanding 1.C Organisms are linked by lines of descent from common ancestry.</p>	DNA Sequencing, RNA and Protein Analyses, Bioinformatics, Comparative Genomics
<p><b>Big Idea 2 Free Energy and Molecular Building Blocks</b></p>	<p><b><i>Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis</i></b></p> <p>Enduring Understanding 2C. Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis.</p> <p>Enduring Understanding 2.D. Growth and dynamic homeostasis of a biological system are influenced by changes in the system's environment.</p> <p>Enduring Understanding 2.E. Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.</p>	Cancer, Identifying Genetic Influence on Disease, Studying the Genome to Understand the Sequence
<p><b>Big Idea 3 Information</b></p>	<p><b><i>Living systems store, retrieve, transmit and respond to information essential to life processes.</i></b></p> <p>Enduring Understanding 3.A. Heritable information provides for continuity of life.</p> <p>Enduring Understanding 3.B Expression of genetic information involves cellular and molecular mechanisms.</p> <p>Enduring Understanding 3.C. The processing of genetic information is imperfect and is a source of genetic variation.</p> <p>Enduring Understanding 3.D. Cells communicate by generating, transmitting and receiving chemical signals.</p> <p>Enduring Understanding 3.E. Transmission of information results in changes within and between biological systems.</p>	DNA Sequencing, RNA and Protein Analyses, Pharmacogenomics, Noninvasive Prenatal Diagnosis, Genetic Information Nondiscrimination Act, Identifying Genetic Influence on Disease, Recombinant DNA and Genetic Engineering, Studying the Genome to Understand the Sequence, Copy Number Variation, Epigenetics, Stem Cells, Synthetic Biology, Therapeutic Approaches: RNAi, Genome Editing
<p><b>Big Idea 4 Biological Systems</b></p>	<p><b><i>Biological systems interact and these systems and their interactions possess complex properties</i></b></p> <p>Enduring Understanding 4.A. Interactions within biological systems lead to complex properties.</p>	Identifying the Genetic Influence on Disease

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Health	5 Evaluate negative and positive impacts of technology on health.	Agricultural, Cancer, Identifying Genetic Influence on Disease, Noninvasive Prenatal Diagnosis, Personalized Medicine, Pharmacogenomics, Recombinant DNA and Genetic Engineering, Stem Cells, Synthetic Biology
	6 Discuss valid and essential information for the safe use of consumer goods and health products.	Agricultural, Cancer, Noninvasive Prenatal Diagnosis, Personal Genomic Analysis, Pharmacogenomics
	10 Determine the causes of disability and premature loss of life across life stages.	Cancer, Identifying Genetic Influence on Disease
Technology Education	26 Explain uses and advantages of databases.	Bioinformatics
	27 Apply appropriate techniques for producing databases.	Bioinformatics
Agriscience	10 Determine characteristics and functions of plants. Explain how agricultural crops can be utilized as alternative fuel sources.	Agricultural Applications
Forensic and Criminal Investigations	7 Describe presumptive and confirmatory forensic tests. <i>Examples: blood type comparison, DNA testing</i>	Criminal Justice and Forensics
	8 Describe the importance of genetic information to forensics Using the process of gel electrophoresis for deoxyribonucleic acid (DNA) fingerprinting.	Bioinformatics, Criminal Justice and Forensics
Foundations of Health Sciences	10 Recognize legal responsibilities, limitations, and implications within the health care delivery setting. <i>Examples: Patients' Bill of Rights, legal documentation requirements, Health Insurance Portability and Accountability Act (HIPAA)</i>	Genetic Information Nondiscrimination Act, Personal Genome Analysis
Health Informatics	5 Describe legal and ethical regulations as they relate to health informatics. <i>Examples: Patients' Bill of Rights, legal documentation requirements, Health Insurance Portability and Accountability Act (HIPAA)</i>	Genetic Information Nondiscrimination Act, Personal Genome Analysis
Introduction to Agriscience	16 Analyze biotechnology to determine benefits to the agriculture industry. <i>Examples: improved productivity, medical advancements, environmental benefits</i>	Agricultural Applications, Bioinformatics, Recombinant DNA and Genetic Engineering, Genome Editing
Introduction to Pharmacy	9 Identify classifications of selected drugs. Examples: analgesic, antibiotic, antiemetic	Personalized Medicine, Pharmacogenomics
	11 Differentiate among drug interactions, drug reactions, and side effects.	Personalized Medicine, Pharmacogenomics
Introduction to Biotechnology	1 Trace the history of biotechnology. Describing both scientific and non-scientific careers, roles, and responsibilities of individuals working in biotechnology.	Agricultural Applications, Bioinformatics, Criminal Justice and Forensics, Diagnosing Chromosome Disorders, DNA Sequencing, Pharmacogenomics, Genome Editing. See The Progress of Science (pg. 56)
	4 Correlate key cellular components to function.	See HudsonAlpha iCell® (pg. 56)
	5 Describe the process of meiosis and the cell cycle, including the hereditary significance of each.	Cancer, Diagnosing Chromosome Disorders, Noninvasive Prenatal Diagnosis, Stem Cells
	8 Describe occurrences and effects of sex linkage, autosomal linkage, crossover, multiple alleles, and polygenes.	Cancer, Copy Number Variation, Genetics of Eye Color, Identifying Genetic Influence on Disease

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Introduction to Biotechnology	<p><b>9</b> Describe the structure and function of deoxyribonucleic acid (DNA), including replication, translation and transcription.</p> <p>Applying the genetic code to predict amino acid sequence</p> <p>Describe methods cells use to regulate gene expression.</p> <p>Defining the role of ribonucleic acid (RNA) in protein synthesis</p>	<p>Recombinant DNA and Genetic Engineering, Studying the Genome to Understand the Sequence</p> <p>Bioinformatics</p> <p>Cancer, Comparative Genomics, Epigenetics, RNA and Protein Analyses, Therapeutic Approaches</p> <p>Recombinant DNA and Genetic Engineering, RNA and Protein Analyses, Therapeutic Approaches</p>
	<p><b>11</b> Describe factors such as radiation, chemicals and chance.</p>	Cancer, Infectious Disease, Genome Editing
	<p><b>13</b> Differentiate among major areas in modern biotechnology, including plant, animal, microbial, forensic, and marine.</p> <p>Describing techniques used with recombinant DNA</p>	<p>Agricultural Applications, Bioinformatics, Criminal Justice and Forensics, DNA Sequencing, Infectious Disease</p> <p>Agricultural Applications, DNA Sequencing, Synthetic Biology</p>
	<p><b>14</b> Explain the development, purpose, findings, and applications of the Human Genome Project.</p> <p>Analyzing results of the Human Genome project to predict ethical, social and legal implications</p> <p>Describing medical uses of gene therapy, including vaccines and tissue and antibody engineering.</p> <p>Using computer bioinformatics resources to provide information regarding DNA, protein, and human genetic diseases</p>	<p>Comparative Genomics, Copy Number Variation, DNA Sequencing, Identifying Genetic Influence in Disease, Personalized Medicine, Pharmacogenomics, Studying the Genome to Understand the Sequence</p> <p>Criminal Justice and Forensics, Genetic Information Nondiscrimination Act, Personalized Genomic Analysis</p> <p>Cancer, DNA Sequencing, Infectious Disease, Recombinant DNA and Genetic Engineering, RNA and Protein Analysis, Genome Editing</p> <p>Bioinformatics, Cancer, Comparative Genomics, Copy Number Variation</p>
	<p><b>15</b> Describe the replication of DNA and RNA viruses, including lytic and lysogenic cycle.</p>	Infectious Disease
Plant Biotechnology	<p><b>1</b> Identify career opportunities associated with plant biotechnology.</p>	Agricultural Applications
	<p><b>14</b> Describe the ecological and economic importance of plants.</p>	Agricultural Applications
	<p><b>16</b> Explain the historical significance of plant biotechnology.</p>	Agricultural Applications, Comparative Genomics; See also The Progress of Science Timeline (pg. 56)
	<p><b>17</b> Describe methods of genetic engineering.</p>	Agricultural Applications, Genome Editing