

Biology for grades 9-12
2017 Science P.L.U.S. Institute
Roper Mountain Science Center
Greenville, South Carolina

Academic Course Description:

Hands-on, inquiry-based activities emphasizing the process of science will provide activities for understanding concepts that correlate to the high school biology South Carolina Science Academic Standards. Course topics will provide additional content to help develop a firm knowledge of molecular, genetics, and biochemical processes needed for high school and AP biology teachers. Participants will receive many materials for performing the activities in their own classrooms.

Outline of Course Content:

Main standard: H.B.I. The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understanding of science content.

	Topics	Activities or Assignments	Correlation to SC Science Academic Standards
Monday	Energy transfer and enzymes. How do enzymes work? How do plants and animals acquire and use energy?	Measure enzyme activities & investigate parameters that influence enzyme activity; apply process of science; observe and measure different steps of respiration in plants	<p>H.B.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.</p> <p>H.B.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.</p> <p>H.B.2B. Conceptual Understanding: Organisms and their parts are made of cells. Cells are the structural units of life and have specialized substructures that carry out the essential functions of life. Viruses lack cellular organization and therefore cannot independently carry out all of the essential functions of life.</p> <p>H.B.3A. Conceptual Understanding: Cells transform energy that organisms need to perform essential life functions through a complex sequence of reactions in which chemical energy is transferred from one system of interacting molecules to another.</p>
Tuesday	DNA as information	Make DNA models; model replication, transcription, translation, protein folding, mutations; isolate DNA from themselves, set up PCRs, pour gels	<p>H.B.2B. Conceptual Understanding: Organisms and their parts are made of cells. Cells are the structural units of life and have specialized substructures that carry out the essential functions of life. Viruses lack cellular organization and therefore cannot independently carry out all of the essential functions of life.</p> <p>H.B.4: The student will demonstrate an understanding of the specific mechanisms by which characteristics or traits are transferred from one generation to the next via genes.</p> <p>H.B.4A. Conceptual Understanding: Each chromosome consists of a single DNA molecule. Each gene on the chromosome is a particular segment of DNA. The chemical structure of DNA provides a mechanism that ensures that information is preserved and transferred to subsequent generations.</p> <p>H.B.4B. Conceptual Understanding: In order for information stored in DNA to direct cellular processes, a gene needs to be transcribed from DNA to RNA and then must be translated by the cellular machinery into a protein or an RNA molecule. The protein and RNA products from these processes determine cellular activities and the unique characteristics of an individual. Modern techniques in biotechnology can manipulate DNA to solve human problems.</p> <p>H.B.4D. Conceptual Understanding: Imperfect transmission of genetic information may have positive, negative, or no consequences to the organism. DNA replication is tightly regulated and remarkably accurate, but errors do occur and result in mutations which (rarely) are a source of genetic variation.</p>

Wednesday	Mendelian genetics	Analyze gels from the day before; model chromosome structure & recombination; make kits for collating sequences to assemble “genomes”; bioinformatics exercise; discuss genetic basis of taste	H.B.4C. Conceptual Understanding: Sex cells are formed by a process of cell division, in which the number of chromosomes per cell is halved after replication. With the exception of sex chromosomes, for each chromosome in the body cells of a multicellular organism, there is a second similar, but not identical, chromosome. Although these pairs of similar chromosomes can carry the same genes, they may have slightly different alleles. During meiosis the pairs of similar chromosomes may cross and trade pieces. One chromosome from each pair is randomly passed on to form sex cells resulting in a multitude of possible genetic combinations. The cell produced during fertilization has one set of chromosomes from each parent.
Thursday	Bacteria and plasmids	Transform bacteria; map plasmids using restriction enzymes; pour, load & analyze gels; design plasmids to express foreign proteins on paper; debates pros/cons of GMO crops/animals.	H.B.4B. Conceptual Understanding: In order for information stored in DNA to direct cellular processes, a gene needs to be transcribed from DNA to RNA and then must be translated by the cellular machinery into a protein or an RNA molecule. The protein and RNA products from these processes determine cellular activities and the unique characteristics of an individual. Modern techniques in biotechnology can manipulate DNA to solve human problems.
Friday	Human genetics & ethics; conveying the nature of science	Go through NIH-written exercises on cancer and ethical uses of genetic information; write a “press release” on one of the week’s experiments; discuss limits of knowledge & how to find reliable sources of information	H.B.4B. Conceptual Understanding: In order for information stored in DNA to direct cellular processes, a gene needs to be transcribed from DNA to RNA and then must be translated by the cellular machinery into a protein or an RNA molecule. The protein and RNA products from these processes determine cellular activities and the unique characteristics of an individual. Modern techniques in biotechnology can manipulate DNA to solve human problems.

Daily Activities:

- Taking notes in science journals
- Using engineering and science practices
- Critiquing the activities and making improvements for use in each participant’s classroom
- Practicing the scientific method: observing, making hypotheses based on observations and designing experiments to test them, recording the results of experiments, analyzing data, making conclusions.
- Disseminating results of experiments.
- Questioning evidence