Cold Spring Harbor Laboratory
DNA Learning Center

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Advanced Inquiry Labs at *Regeneron DNALC* 2019-20

Advanced Inquiry labs are for AP, advanced elective, or research classes looking for a wet-lab experience that includes extended analysis of data. While performing open-ended experiments to detect DNA variations in themselves and other organisms, students will have time to explore how online bioinformatics tools are used to analyze DNA. Labs will include use of Basic Local Alignment Search Tool (BLAST), DNA sequence alignments, construction of phylogenetic trees and population simulations.

GMO: Detecting Genetically Modified Foods

Genes that encode herbicide resistance, insect resistance, drought tolerance, frost tolerance, and other traits have been added to many commercial plants – including most of the corn and soybeans grown in the United States. In this laboratory, students isolate DNA from plant tissue and processed food products. Then, polymerase chain reaction (PCR) and gel electrophoresis are used to identify a promoter that drives the expression of most plant transgenes. During the lab, bioinformatics tools allow students to predict the outcome of the experiment and discover genes and functions transferred into GM plants.

PTC: Using a SNP to Predict Bitter Tasting Ability

The ability to taste the bitter compound PTC (phenylthiocarbamide) is often used to illustrate Mendelian inheritance. Three SNPs (single nucleotide polymorphisms) in the gene encoding the PTC taste receptor strongly affect tasting ability. In this experiment, students extract DNA from cheek cells and use PCR to amplify a short region of the gene. After a diagnostic restriction digest, student genotypes are scored on an agarose gel, allowing them to predict their phenotypes. Students then test their tasting ability and compare genotypes and phenotypes, allowing them to discover that PTC tasting is genetically more complex than the model. This experiment is a close analog to how "precision or personalized medicine" uses genotypes to predict drug response. ***Participation in this laboratory requires a signed consent form (provided by the DNALC) from the parent/guardian of each student under 18 years of age**.

Barcoding: Using DNA Barcodes to Identify and Classify Living Things

Just as unique universal product codes (UPC) identify products, unique "DNA barcodes" use specific DNA sequences to identify living things. In this laboratory, students use DNA barcoding to identify plants, fungi, or animals – or products containing them. DNA is extracted from samples, the barcode region is amplified by PCR, and the PCR product is sequenced. *DNA Subway*, an online bioinformatics site, is used to search a DNA database for close matches to sample sequences and to construct phylogenetic trees that show evolutionary relatedness. Students have the option of bringing in their own samples to test, providing the opportunity for mini-projects to sample local environments or to test food products.

Extended FP: Using an *Alu* Insertion Polymorphism to Study Human Populations (extension of Human DNA Fingerprinting)

The DNA from any two people varies at many sites. These polymorphic sequences that make each person's DNA unique are used in the study of human evolution. This experiment examines a polymorphism that is caused by the insertion of an *Alu* transposon, the most common DNA sequence in the human genome. DNA is extracted from student cheek cells, and PCR is used to amplify the region containing the *Alu* insertion site. Students score their genotypes on an agarose gel, and the compiled class results are used as a case study in human population genetics. On the *Bioservers* Internet site, students use tools to test Hardy-Weinberg equilibrium, explore the geographic distribution of the insertion in world populations, and simulate the inheritance of a new *Alu* insertion. ***Participation in this laboratory requires a signed consent form (provided by the DNALC) from the parent/guardian of each student under 18 years of age**.

Reservation Details:

Limited to maximum of 24 students.
8:30 a.m.-2:30 p.m. (6 hours)
Lab rate: $32 per student, minimum fee ($640) for 20 students or fewer.