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Using the Innocence Project to Engage Non-majors in DNA Analysis

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Extended Abstract

Biotechnology is such a broad term that encompasses a variety of DNA manipulations and analytical techniques. In this lab, students focus on a group of these techniques that are involved in DNA fingerprinting. The students get hands-on experience with a few of these techniques. If you ask most students today they will have seen at least one of the many TV crime dramas such as "CSI: Crime Scene Investigation". On each episode of these shows there is usually a reference if not a major plot point that involves DNA forensics or the use of DNA to identify individuals. In this lab student use DNA to identify people in the same way.

In this lab there were 3 basic activities: 1) Practice Electrophoresis 2) Genetic Frequency Analysis and 3) Crime Case Analysis. In the crime case analysis activity, students used DNA fingerprinting to reevaluate an old criminal case. The students acted as a group from the Innocence Project which is a national legal organization that exclusively uses DNA evidence to exonerate wrongfully convicted people. Each group of students got information about a different criminal case that has previously been tried and decided. The groups must determine if DNA analysis provides new and different evidence in their case.

In Exercise 1, the students loaded and ran samples on an agarose gel. The DNA samples were food coloring samples that moved through agarose in the same way that DNA does from the negative electrode to the positive electrode. The samples represented an individual's DNA for one gene that has been digested with a restriction enzyme. Students also looked at the DNA sequence of this gene, transcribed it to mRNA and translated the mRNA to an amino acid sequence.

In Exercise 2, students learned about Mendelian inheritance and calculated genetic frequencies. Students determined their phenotypes and possible genotypes for 7 different traits controlled by a single gene. They calculated the frequency of each phenotype in the class population. This emphasizes the genetic variation in a population and how you can use the frequencies. This exercise was completed while the agarose gel from Exercise 1 is running.

In Exercise 3, groups analyzed simulated crime case gels. It was important for students to understand that STRs, short tandem repeats, are short sequences of non-coding DNA regions that are variably repeated between different individuals. For simplicity sake, the DNA fingerprints created by each group in class represent STRs of only one locus (or genetic marker). In actual forensic studies, more than one genetic marker is analyzed and potentially up to 13 or more markers are analyzed. The students may not be able to make a definitive determination based on one genetic marker and that should be pointed out, but with one genetic marker it is possible to definitively exclude an individual. It is acceptable if they concluded that further analysis is needed. The students made a presentation to the whole class about their client's case with information about the original conviction and the newly analyzed DNA fingerprints. The point of this activity is to expose the students to the science behind DNA fingerprinting so they will better understand how it is used in various identification applications.

Keywords: DNA analysis, Innocence Project

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Notes to the Instructor

The crime case gels were simulations created on paper. After a semester or two of having students load and run DNA on the crime case gels with variable quality, we determined that it was better to have the gels on paper so that students would have the correct information to analyze. See a sample crime gel (Fig. 1)

The crime case files were created using a compilation of the case questionnaire, police questionnaire, and evidence questionnaire from the North Carolina Center on Actual Innocence.

Literature Cited

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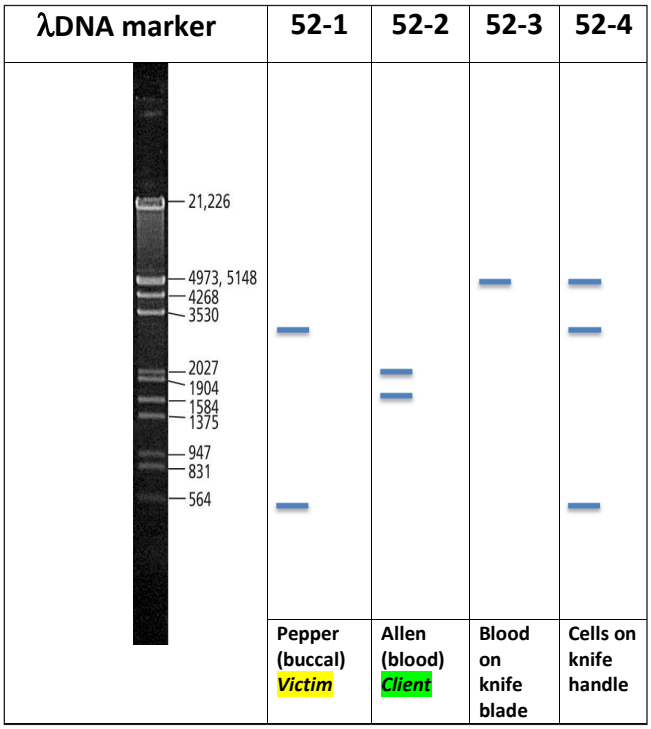

Figure 1. Sample Crime Case Gel. This gel includes a DNA marker, DNA from the victim, from the client and from evidence collected at the crime scene.

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