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| Course Title: **Forensics**  **Dr. Castro room 320 - Grades 12** | Unit/Organizing Principle: Unit 2 The-crime-scene processing. **DNA Barcoding and DNA Extraction - Projects** | | Timeline: **Six weeks 11week** |
| **Key Academic Vocabulary: amelogenin gene, amino acids, buccal cells, chromosome, complementary base pairing, deoxyribonucleic acid (DNA), electrophoresis, epithelial cells, human genome, hybridization, low copy number, mitochondria, multiplexing,** **nucleotides (A, T, C, G), pictogram, polymer, polymerase chain reaction (PCR), primer, proteins, replication, restriction enzymes, restriction fragment length polymorphisms (RFLPs), sequencing, short tandem repeat (STR), substrate control, tandem repeat, Y-STRs, hydrogen bonds.** | | | |
| **Stage 1 Desired Results** | | | |
| ESTABLISHED GOALS  **NGGS(HS-LS2-1) (HSLS2-2).RST.11-12.7**  **Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem**. (HS-ETS1-1),(HS-ETS1-3)  **MS-PS1-1.** Develop models to describe the atomic composition of simple molecules and extended structures.  **MS-PS1-2.** Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical  **NGSS (9-12.Engineering Design).**  Developing and Using Models  Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show how relationships among variables between systems and their components in the natural and designed worlds.  **LS4 (9-11) NOS+INQ -9**. Students demonstrate an understanding of how humans are affected by  environmental factors and/or heredity by …  **9a** researching scientific information to explain how such things as radiation, chemicals, and other factors can cause gene mutations or disease.  **Standards LS4 (9-11) NOS + Inq-9a**: Students demonstrate an understanding how humans are affected by researching scientific Information.  **Common Core Standards**: **WHST- 9-12.2 (HS-LS 2-1) (HS-LS 2-2)** Write Informative/Explanatory texts, including the narration of historical events, scientific procedures experiments/ or technical processes.  **LS1 (9-11) FAF+ POC -2**  **Explain or justify with evidence how the alteration of the DNA sequence may produce new gene combinations that**  **make little difference, enhance capabilities, or can be harmful to the organism (e.g., selective breeding, genetic**  **engineering, mutations).**  **LS1 (9-11) –2. Students demonstrate an understanding of the molecular basis for heredity by …**  **2a describing the DNA structure and relating the DNA sequence to the genetic code.** | ***Transfer*** | | |
| ***Students will be able to independently use their learning to****…*   1. **The student will be able to investigate how DNA can be extracted from cells.** 2. **The student will be able to recognize components of DNA and understand how the information for specifying the traits of an organism is carried in the DNA** 3. **Students will be able to explore, organize, analyze, evaluate, make inferences, and predict trends in data.** 4. **The students will be able to evaluate models according to their adequacy in representing biological objects and events.** 5. **The students will be able to use models to show the structure of DNA and how this structure relates to the function of storing, copying, and transmitting information.** 6. **The students will be able to develop important academic, interpersonal, and intrapersonal skills that are necessary for their future success, including problem-solving, critical thinking, and teamwork** | | |
| ***Meaning*** | | |
| **UNDERSTANDINGS**  *Students will understand how detectives work in the real life situations, and how scientists use DNA samples to give answers in the courtroom.*  Students will understand that all the information required by organisms to maintain life is encoded in the arrangement of nucleotides in their DNA.  Students will understand the reciprocal relationship between basic science research and technology development: They understand that the discoveries of plasmids, restriction enzymes, and ligases during basic research have generated the tools and techniques of biotechnology; in turn, the tools and techniques of biotechnology are enabling scientists to reach deeper understandings about genes and the function of their products in a cell.  Students will recognize that a change in the DNA sequence can alter the function of a protein and can change the traits of an organism. | ESSENTIAL QUESTION(S)   1. What are the appropriate roles for scientific technology and human judgment in bringing criminal charges against a defendant? 2. What is the relationship between DNA replication and the cell cycle? | |
| ***Acquisition*** | | |
| ***Students will know..****. The students will know how to design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through science as inquiry.* | *Students will be skilled at…*   * *The use and location of all safety equipment in the laboratory.* * *The use of equipment: micropipette, electrophoresis chamber, agarose gel electrophoresis, digital balance, shaking incubator, vortex mixer etc…* * To visualize the solutions in real life situations. * Develop investigative questions and design * Familiarity with data collection devices * Prepare to-scale technical drawings * Classroom presentations * Use of internet for needed information, save web addresses, collect information and save. | |
| **Stage 2 - Evidence** | | | |
| **Evaluative Criteria** | **Assessment Evidence** | | |
| Students will be graded on each of the following criteria by using a rubric: (see attachment)   * Safety protocol during Labs * Group participation * Class participation. I use the results on both types of assessments formative and summative to determine which concepts need to be re-taught * Lab reports, Brochures, Portfolio work. * Student’s performance – The use the equipment and supplies. | PERFORMANCE TASK(S) - Summative assessment.  Ask and review questions- facts concepts, and reflections. (DOK3 Strategic Thinking) Form conclusions from experimental or observational data. Cite evidence and develop a logical argument for concepts. Research and explain a scientific concept.   1. What did you learn?  * How did your team work/collaborate? Was there one or more people not fully participating in the process? Would you change any of the dynamics of the group? Team work * Group discussion, case study and analysis of data results. Have the students identify and analyze physical evidence from O.J. Simpson case. Collection and preservation of biological evidence for DNA analysis. The combined DNA Index system (CODIS). * Application and critical thinking questions. | | |
|  | OTHER EVIDENCE   * **Laboratory Reports, Brochures and Project Prezi presentations.** ( Summative assessment ) * **Do Now** ( Formative assessment) * **Learning activities**- Cooperative Learning (Formative assessment) * **Homework**. (Formative assessment) * **Portfolio Sample**. * **Pushing the learning**: How DNA fingerprinting is used in crime investigation. How have advances in DNA technology helped to ensure justice is being served? Should juries rely solely on DNA evidence in determining the guilt of accused individuals in capital murder cases? How reliable is DNA evidence? | | |
| **Stage 3 – Learning Plan** | | | |
| *Summary of Key Learning Events and Instruction/Each lesson may take more than one day*   * **Lessons - Teacher Notes**:   The Barcoding Life’s Matrix project provides instructors with the training, instructional resources, and Web-based informatics tools needed to help their students meet the data standards and join iBOL scientists in their efforts to create a global reference DNA barcode library of Earth’s multicellular life. Genomic DNA is extracted from a tissue source and a ~ 650 base pair fragment of the CO1 gene is amplified using polymerase chain reaction (PCR). The size of the resulting CO1 amplicon is then verified by agarose gel electrophoresis before being purified and submitted to a commercial facility for bidirectional sequencing. The sequencing facility will return two trace files containing the nucleotide sequence for the corresponding strands of the submitted DNA fragment. An integrated suite of informatics tools available through the BOLD Student Data Portal (BOLD-SDP) is subsequently utilized by students to create contigs assembled from both trace files. Reference barcode sequences are integrated into comprehensive electronic data records that contain additional forms of mandatory information related to the source specimen and the collection event. Virtually all species have distinct barcode gene sequences. Building a public library of barcode sequences from museum reference specimens is the first step. After that, unknown specimens can be identified by ‘looking up’ their sequences in the reference library.  “DNA barcoding” is an exciting new tool for taxonomic research. The DNA barcode is a very short, standardized DNA sequence in a well-known gene. It provides a way to identify the species to which a plant, animal or fungus belongs. The barcode of an unidentified specimen can be compared with the reference barcodes to find the matching species. The DNA barcode of an unidentified specimen can be read using standard gene sequencing techniques. DNA barcoding includes three types of activities: **Working with organisms**, collecting, identifying, and preserving voucher specimens in secure repositories**; Laboratory procedures**: sampling and processing tissue from specimens to obtain DNA barcode gene sequences. **Managing data:** sharing the DNA barcode sequence and data about its voucher specimen in a public database.  The DNA barcode sequence includes about 650 DNA “base-pairs” (represented by the letters A, C, G and T). That’s a tiny portion of the billions of base pairs that make up the entire genome of many organisms. Barcoding is done with a well-known gene, not a newly discovered gene. It is used for identifying specimens, not for biomedical purposes such as developing pharmaceuticals.  **Demonstrations – Minilabs**: **1A. Micro-pipetting and Micro-volumes**. **Objectives**: The students will learn to become familiar with the small volumes of solutions used in molecular biology, Introduce proper use of the micropipette, and also practice using the micropipette and also pipetting techniques. **1B. Gel electrophoresis. Objectives:** students will be able to do the technique of gel electrophoresis correctly. Explain the importance of micropipettes and gel electrophoresis in genetic engineering. Describe how gel electrophoresis separates DNA. Explain how genetic engineering can be used to treat some genetic diseases. **1C. DNA extraction. Objectives:** The students will extract DNA from some of their cells. Demonstrations and minilabs the teacher will instruct and modeling about proper use of the equipment and also safety issues.  **Classroom management notes**: Cells from the lining of the mouth come loose easily, so the students will be able to collect cells containing their DNA by swishing a liquid around in their mouth. To extract DNA from their cells, the students will need to separate the DNA from the other types of biological molecules in their cells. The students will be using the same basic steps that biologists use when they extract DNA (e.g. to clone DNA or to make a DNA fingerprint). The students will follow these 3 easy steps to extract the DNA: Detergent, enzymes (meat tenderizer)  and alcohol.  **Activity 1D. Introduction to DNA Barcoding. Objectives:** The students will be able to give an outline of the process necessary for DNA barcoding  of rockfish, and also explain the difference between nuclear and mitochondrial DNA. The teacher is going to explain the barcode metaphor  through a Prezi presentation. **Classroom management notes**: This introductory presentation provides a brief history of DNA barcoding, a  description of the DNA barcoding pipeline, and an introduction to the International Barcode of Life (iBOL) project and the Barcode of Life Data  Systems (BOLD). To provide an appropriate context for subsequent discussions centered on a role for DNA barcoding in species identification  and discovery, this Program Primer compares estimated rates of species loss with the rate of species identification using Linnaean taxonomy.  DNA barcoding is a species identification system that pairs a standardized gene sequence with other types of retrievable information stored in  an electronic database (the Barcode of Life Data Systems). This unit begins by comparing and contrasting the UPC (Universal Product Code)  barcode system used to track consumer products, with the DNA barcode system developed by iBOL scientists to identify species groups. To  prepare students for the laboratory segment of the program and help them understand the evolutionary constraints imposed on the DNA  barcode sequence, the unit guides them through an extensive review of fundamental molecular life science topics.  **Laboratory 1: Isolation of genomic DNA (gDNA) from fish tissue (lysis). Objectives:** The students will givethe two locations DNA resides.  Define genomic DNA (gDNA) or total DNA. Describe what is happening in a digestion with each of these reagents: Proteinase K ,RNase. List  the other macromolecules present within your sample. Explain how to separate DNA from other macromolecules. Define the terms binding,  elute lysis, wash and provide the order they occur to isolate the genomic DNA.  The teacher will model observational skills, questioning techniques, and formulating hypotheses and also lecture the students with a power  point presentation**. Classroom management notes:** Mitochondria are membrane-bound organelles that generate most of the cell’s supply of ATP  (adenosine triphosphate) through oxidative phosphorylation. The COI barcoding gene resides in the mitochondrial genome, a circular, double-  stranded DNA molecule between 15,000 and 17,000 base pairs (bp) in length. In order to copy and amplify a fragment of the COI gene for the  purposes of DNA barcoding, you must first isolate total DNA from fish tissue. Total DNA (sometimes called genomic DNA or gDNA) consists of  both nuclear DNA (nDNA) and mitochondrial DNA (mtDNA). In general, each cell contains between 100 and 10,000 separate copies of mtDNA.  In addition to containing the COI gene, the mitochondrial genome encodes 12 protein coding genes involved in oxidative phosphorylation  and ATP production, 22 transfer RNA (tRNA) genes, and genes encoding the small and large subunits of ribosomal RNA (rRNA).  **Materials needed**: SL-200 micropipettes and tips, shaking incubator, vortex mixer, disposable gloves, microcentrifuge tubes labeled with  Appropriate specimen ID containing fish tissue, digestion buffer, and proteinase K.  **Laboratory 2:**  **Purifying total DNA (gDNA) from tissue lysates**. **Objectives:**  the students will add binding buffer to the cell lysates and transfer them into a spin column containing a silica matrix that selectively binds DNA. The teacher will review the test tubes with specimen tissue in lysis buffer containing Proteinase K, and also the tubes now contain a cell lysate consisting of digested proteins, carbohydrates, lipids, RNA, DNA, and other  material**. Classroom management notes:** In Laboratory 1, you incubated specimen tissue in lysis buffer containing Proteinase K. The tubes  now contain a cell lysate consisting of digested proteins, carbohydrates, lipids, RNA, DNA, and other material. In order to isolate gDNA (nuclear andmitochondrial DNA) from these other macromolecules, you will add binding buffer to the cell lysates and transfer them into a spin column containing a silica matrix that selectively binds DNA. When the spin column is placed in a microcentrifuge, centripetal force pulls the cell lysate through the silica matrix; DNA binds and becomes trapped in the silica matrix as the other macromolecules freely pass through the matrix and into a collection tube. Once the DNA is bound to the matrix, two wash steps are performed to remove unbound contaminants from the matrix. In the last step of the protocol, a small volume of water is used to remove (elute) the DNA from the column matrix. During the final centrifugation step, unbound DNA will be pulled to the bottom of a clean collection tube. This purified DNA solution will contain a mixture of nuclear DNA (nDNA) and mitochondrial DNA (mtDNA). mtDNA will be used in Laboratory 5 as a template to copy and amplify a COI gene fragment using Polymerase Chain Reaction (PCR).  **Materials needed:** refrigerator/freezer, SL-1000 micropipettes and tips, SL-200 micropipettes and tips, SL-20 micropipettes and tips, microcentrifuge  vortex mixer, disposable gloves, fine point permanent markers, spin columns, collection tubes, 1.5 mL microcentrifuge tubes, RNase A, Binding Buffer  100% ethanol (EtOH), Wash Buffer 1, Wash Buffer 2, dH2O.  **Laboratory 3:** **Casting an agarose gel to examine gDNA by agarose gel electrophoresis. Objectives:** The students will describe the basic principal of gel electrophoresis. Describe the following list of tools Electrophoresis chamber- Gel casting tray- Sample combs- Power supply. Explain the purpose of gel loading buffer and list the contents of the buffer. Explain how the DNA visualized. Describe the purpose of running gel with gDNA.  The teacher will model to the students the safety and use of the equipment and also the teacher will discuss the main ideas after we watch a video simulation. **Materials needed**: digital balance, microwave oven, 4˚C refrigerator, graduated cylinders, electrophoresis chamber, gel casting tray, 10-well gel comb, 250 mL or 500 mL flasks, Kimwipes, weighing paper, rubber “hot hand” protector, disposable gloves, freezer bags, fine point permanent, markers, 1X TAE buffer, agarose powder, ethidium bromide solution (10 mg/mL)-Note this solution have to be changed, because it is illegal to use EB in RI**. Classroom management note**: Agarose gel electrophoresis is a laboratory procedure that is routinely used to separate and visualize DNA fragments by their size. For this procedure, a gel containing a porous matrix of agarose (a complex polysaccharide) is cast. The porous gel is then submerged in an electrically conductive buffer (TAE) and DNA is loaded into small depressions (or wells) that are molded into the gel. Once the DNA is loaded into the wells, a DC electrical current is passed through the agarose gel and conductive buffer. Because DNA carries a net negative charge (due to the negatively charged phosphate molecules that form its backbone), it will migrate through the agarose matrix toward the anode (or positive terminal) of a buffer-filled electrophoresis chamber. If DNA fragments of different sizes are loaded into a single well, they will migrate at different rates through the agarose matrix; smaller DNA fragments are able to move more quickly through the matrix than larger fragments.  **Laboratory 4: Examining purified gDNA with agarose gel electrophoresis**  **Laboratory 5 :Targeted amplification of the COI barcode region from a gDNA template**    **Lab 4 and Lab 5: Group discussion: teacher and students will be Asking and reviewing questions- facts concepts, and reflections. (DOK3 Strategic Thinking) Form conclusions from experimental or observational data. Cite evidence and develop a logical argument for concepts. Research and explain a scientific concept.**  **Common Misconceptions:**  **Most students will probably link forensics with crime due to popular TV shows. Yet, forensic science is any science used in the courts, the justice system, or in public investigations, and these investigative methods can be used in many situations beyond criminal cases. Students should understand that crime scene investigations usually require a team of forensic scientists who do most of their work in laboratories because this work requires knowledge of several scientific disciplines: often one person lacks the necessary educational background and expertise to conduct the entire investigation alone. This scenario is illustrated well on popular TV shows. For example, a ballistics expert may be a physicist and a forensic pathologist will be a medical doctor, while the scientist analyzing blood samples may be a chemist or biologist.** | | | |
| **Differentiation Plan** | | | |
| *Refer to classroom data/English Language Proficiency Level (ACCESS), IEP/504 accommodations, and differentiation strategies*   * Hands-on project base learning, in order to encourage student engagement and success. * Flynn Scientific Student Safety contract (Spanish), videos. * Organize students with a mix of students with different academic and linguistic skills. * Students work in small groups focused upon the specific tasks. * The discussions should be task oriented to conduct the experiment. * They will be paired in groups of threes working cooperatively. * The small group activities are using models to learn concepts and solving problems. * Demonstrations and the use more pictorial strategies help ELL students understand concepts * Use skeletal notes to aid students with limited English proficiency in note taking skills * Give special attention to those students who require more structure, demonstrations and simulations help to grasp main concepts. * Increase time required whenever possible to complete assignment or modify activity requirements. * I will provide after school tutoring. * I will plan future instruction by paying attention to both the scientific conceptual learning as well as linguistic obstacles. * PowerPoint with accompanying worksheets. * Consistent use of videos, simulations and demonstrations to help the students to grasp and visualize the main concepts. | | | |
| **Resources** | | | |
| * Castro’s website (**drcastro.weebly.com** ) * Laptops computers. * Forensic Science an Introduction, By Richard Saferstein. Chapter-9 pages 308 to 353. * Technology Web Extras: delivery bonus internet related information. * Forensics’ Syllabus. Basic Lab Exercises for Forensic Science. * CASE READING The Forensic Community’s Response to September 11: Chapter 9 pages 349-353 | | | |

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