



Lesson Plan Template

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“Solving the Mystery of an unknown Marker Type – The Chromatography Lab” and “Using an Actual DNA Gel to Identify Cottonwood Population Diversity”

Content Area: Biology

Grade: 9-10

Duration: 3 class days

Career Technical Industry Sector:

X

Agriculture and Natural Resources

Hospitality, Tourism, and Recreation

Standards and Benchmarks:

California State Standards for Biology –

Genetics

5. The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells.

As a basis for understanding this concept:

D. Students know how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation, and transformation) is used to construct recombinant DNA molecules.

Evolution

7. The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time. As a basis for understanding this concept:

A. Students know variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.

Agriculture and Natural Resources Industry Sector

E10.0 Students understand forest management practices:

E10.4 Analyze harvest and renewability (e.g., re-seeding and thinning) systems and identify the impact of each on the land.

SCANS Foundation:

Reading: Identify relevant facts; locate information in books/manuals; find meanings of unknown words; judge accuracy of reports; use computers to find information.

Writing: Write ideas completely and accurately in letters and reports with proper grammar, spelling, and punctuation, use computers to communicate information.

Teamwork: Contribute to group with ideas and effort; do own share of work; encourage team members; resolve differences for the benefit of the team; responsibly challenge existing procedures, policies, or authorities.



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	<p>Self-Management: Assesses self accurately, sets personal goals, monitors progress and exhibits self control.</p> <p>Problem-Solving: Recognize problem; identify why it is a problem; create and implement a solution; watch to see how well solution works; revise as needed.</p> <p>SCANS Competencies:</p> <p>Resources: <i>Material and facilities</i> - acquires, stores, allocates, and uses materials or space efficiently</p> <p>Interpersonal: <i>Participates as member of a team</i> - contributes to group effort</p> <p>Information: <i>Acquires and evaluates information ,Organizes and maintains information ,Interprets and communicates information</i></p> <p>Technology: <i>Applies technology to task</i> - understands intent and proper procedures for setup and operation of equipment</p>
<p>Objectives:</p>	<p>Students will know the advantage of diversity within a population.</p> <p>Students will know how to run a chromatography DNA gel (using coffee filters and water based black markers), giving them experience in how organisms can be identified by using a gel in a DNA lab, such as the National Forest Genetic Electrophoresis Lab in Camino, CA.</p> <p>Students will look at the results of an actual DNA electrophoresis Gel, supplied by NFGEL, of six populations of Cottonwood Species and be able to determine genetic diversity within the populations..</p> <p>Students will know how species diversity, or lack of, helps with Forest Management decisions.</p>
<p>Resources and Materials:</p>	<ul style="list-style-type: none"> • Handout “Why is Genetic Diversity Important?” • DNA Chromatography Lab • Lab Materials as outlined in DNA Chromatography Lab • DNA Chromatography Lab Rubric • DNA Electrophoresis Gel Results • DNA Electrophoresis Gel Worksheet • DNA Electrophoresis Gel Rubric • Text
<p>Differentiation:</p>	<p>Basic Skills: Students meeting the basic skills will understand the importance of genetic diversity both between and within species. Students will understand that if we know the fingerprint of one thing, we can compare it to some unknown samples and determine its identity, much the same way investigators do in criminal labs. Students should be able to define heterozygous, homozygous, genotypes, alleles, dominant and recessive.</p>



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	<p>Higher level: Students will know how knowledge on species diversity may lead to better forest management practices. Students will apply the concept of genetic diversity within species to evolution of all species as environmental factors change. Students will understand the importance of having a control in labs. Students will be able to identify which unknown is missing a fingerprint on the map key. Students will demonstrate what reasons there may be for the missing key. Students make the connection with the Marker and coffee gel to DNA of trees in a US National Forest grove.</p>
<p>Preparing Students for the Lesson:</p> <ul style="list-style-type: none"> • Transitions • Expected Behaviors 	<p>Students will take Cornell Notes on Biology Chapter Reading that is relevant to species diversity, DNA, and land management.</p> <p>Teacher will review proper lab behavior and technique.</p> <p>Teacher will monitor students after transitions and during lab to minimize distractions and maximize success.</p>
<p>Teaching the Lesson (Lesson Sequence/ Activities):</p> <ul style="list-style-type: none"> • Motivation/ Anticipatory Set • Pre-Assessment/ Activating Background Knowledge • Teacher Input, Modeling, & Checking for Understanding • Guided Practice • Independent Practice • Closure 	<p><i>Solving the Mystery of an unknown Marker Type – The Chromatography Lab</i></p> <p><i>Anticipatory Set / Pre-Assessment:</i> Class discussion.</p> <p>Teacher will ask students “What is the purpose of having genetic diversity in our National Forests?” Lead students to the understanding that genetic diversity allows populations to survive when unfavorable conditions arise, such as climate change, invasive insects and fungi.</p> <p><i>Guided Practice:</i> Hand out “Why is Genetic Diversity Important?” Class should read the article written by United States Forest Scientists as a class, in small groups, or as individuals. Answer questions as you read. When finished, discuss answers (provided on key to handout) as a class to ensure students understand the article before transitioning to the lab. (20 minutes)</p> <p><i>Discussion (Teacher input):</i> Lab safety and behavioral expectation. Share a list of traits that are necessary for all lab scientists, including Forest Service Scientists, CSI Investigators, Cancer Research Scientists, etc. A brainstorm on what types of research is being done in labs across the world, and how that research will improve quality of life would be appropriate. Poor lab skills and cooperation would lead to poor experimental results, and a loss of time and money to research team. (10-15 minutes)</p> <p><i>Lab (Independent Practice):</i> DNA Chromatography Lab – Teacher should walk around making sure that each student is participating and lab procedure is being followed exactly. Teacher can ask review questions to groups such as: “Why do we have 5 different markers? What might that represent in an actual DNA lab? Answer Different markers represent different individual organisms or different species. Students may need assistance with comparing their unknowns to the map that they created. (1 hour)</p> <p><i>Closure:</i> Teacher should discuss findings of the “Gel Run”. There were 5 different pens used.</p>



Each left a fingerprint of the colors that were used in the production of these pens. Each pen should have a unique fingerprint. This is analogous to the DNA in a living organism. Each live organism would have a unique DNA fingerprint. After the lab teams ran their unknown samples on a separate gel (coffee filter), the results could be compared to the map that was previously created with the known pens. By comparing the sets of fingerprints one can conclude which of the pens the unknowns were. If this were a DNA gel, the unknowns would then be identified to species, region or exact organism, depending on how the DNA gel is used.

What would lead to one of the unknowns being unique? Answer: Lab error, OR, a particular marker that we did not have a map of. In the real world they may have just discovered a new species!!! (20 minutes)

Using an Actual DNA Gel to Identify Cottonwood Population Diversity

Students will learn about a unique local resource located only 10 minutes from Placerville, the National Forest Genetics Electrophoresis Laboratory. This science lab is one of a kind in the United States, conducting genetic analysis for the purpose of Land Management, Criminal Prosecution, Genetic Mapping and for Forest Service studies as well as Private Industry Studies.

Background: Teacher will need to discuss the terms heterozygous, homozygous, genotypes, alleles, dominant and recessive. (10 minutes)

Modeling/Guided Practice: Teacher will need to read *DNA Electrophoresis Gel* with students. Questions regarding terminology and directions may arise, and all students will benefit from instructions. It is also suggested that teacher model the first reading of the gel, by using a projection. Walk students through the process of looking at the gel results for one organism and determining its genotype. Then have students work in pairs/groups to determine all organisms' genotypes. (15 minutes)

Independent Practice: Teacher should walk around and monitor students' progression in determining genotypes based on the DNA gel fingerprints. Students should answer the questions that accompany the DNA *Electrophoresis Gel* on their own or in small groups. (30 minutes)

Closure: Teacher should discuss that Cottonwoods, like Aspen, sometimes generate from root runners, meaning that all organisms within a particular grove, or population, may in fact be genetically identical. This is the reason that three of the populations of Cottonwood in the gel were genetically identical (two were heterozygous, and one was homozygous). The other reason that may lead to genetically identical organisms is that an environmental factor may be pressuring for it, Natural Selection. There may be an advantage to having a heterozygous genotype, and there may be a fatal pressure against homozygous genotypes. Although this case is rare in nature, it has been known to play a role in determining genotypes. (10 minutes)



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	<p><i>Enrichments:</i> Local schools can request a school visit by a National Forest Genetic Electrophoresis Lab employee.</p> <p>Local Schools can schedule a field trip to NFGEL in Camino, where they would happily lead tours of their facilities and work with schools in setting up gels before hand for students to learn from.</p>
Assessment:	<p>Informal Assessment: During the class periods, the teacher will monitor student progress, assist with formulating thoughts/answers, and observe student behavior during lab while circulating around the room. Students will be given assistance and guidance as needed and as requested.</p> <p>Formal Assessment: Students will be scored on accuracy of worksheet “Why is Genetic Diversity Important?” answers. Students will each hand in their own lab, even though the lab was conducted as a group. Name of student who did the write up is on top, with lab partners written underneath. One lab form each group, chosen randomly, will be scored, and the entire group will receive the same score. It is the hope that this technique will result in sharing of thoughts and answers benefitting all members of the lab group. Exceptions can be made based on teacher discretion to accommodate poorly functioning groups and lower performing students that are making a genuine effort but at the same time, not producing a high quality lab write up. Students are assessed on the DNA Electrophoresis Gel using the identification of genotypes and alleles and answering accompanying questions.</p>
Notes & Reflections:	

Externship Sites:	National Forest Genetic Electrophoresis Laboratory	Institute of Forest Genetics	
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