THOMAS J. DEVRIES

Vashon Island High School
Vashon School District #402
20120 Vashon Highway SW
Vashon, WA 98070
tdevries@vashonsd.wednet.edu

Following stints as a post-doc in oceanography (Oregon State University) and research professor in geology (The University of South Carolina), I came to Vashon to teach high school science in 1992.

I teach a freshman Physical Science course and electives in Environmental Science, Marine Science, and Molecular Evolution. The latter course focuses on the sometimes contradictory paleontological and molecular evidence concerning the evolution of cetaceans.

I participated in the SEP program in 1995 and followed up in 1996 and 1997 with a Research Corporation/M. J. Murdock grant to work in Scott Edwards' molecular evolution lab at the University of Washington.

In a life parallel to that in the classroom, I conduct research in Cenozoic invertebrate paleontology and stratigraphy in Peru, which recently involved a five-month field season in Peru as a Fulbright Senior Research Scholar.

VASHON ISLAND HIGH SCHOOL
VASHON SCHOOL DISTRICT
THOMAS J. DEVRIES
JASON TANGUAY

- 3 sections sophomore Biology (2 General, 1 Basic), repeated for 2 trimesters (2001-2002)
- 70 minute class periods
- 20-30 students per class
- 8 lab groups of 3 or 4 students

Also

- 1 section junior/senior elective in Environmental Science (2001)
- 70minute class periods
- 24 students
- 6 lab groups of 3 or 4 students

In both the biology and environmental courses, the Elephant Project was incorporated as part of a larger unit on conservation biology.

Biology students had a wide range of backgrounds and abilities. Some had no prior instruction about DNA other than a one-period overview. Students with previous knowledge of DNA had a more enriching experience.

Students in all classes had learned how to use micropipets and gel electrophoresis boxes in their freshman Physical Science course. Nonetheless, it was necessary to spend a day re-acquainting them with the equipment.

HOW I CUSTOMIZE THE ELEPHANT PROJECT FOR MY CLASSES

Time constraints dictated that we proceeded rapidly with the Elephant Project. We employed few of the kit resources other than those directly related to the essential elements of the project.

DAY 1: Review of micropipetting and electrophoresis; "Wildlife Warrior" (clipped version); passing of 'the tooth.'

Need brief overview to establish rationale for biotech review. Need to follow movie with hook to scenario – "It's the ivory, stupid!"

DAY 2: Scenario and discussion; elaborate on biotech solutions; biographies of Comstock and Wasser and pictures of African lab; overview of project; posting of Africa maps.

Grampa scenario worked fine; need to exaggerate drama; emphasize that investigators are real people (current news articles might be available). If time permits, review basic geography of Africa. Consider geography homework assignment.

DAY 3: RFLP Paper Activity; distribution of Internet assignments

We used both options – elephant paragraphs work best. Small differences in lengths are due to spaces between words. Internet assignments parceled out by groups rather than individually. Need to keep track of progress throughout project.

DAY 4: Make gels and store; mix enzyme with unknown ivory sample and incubate.

Groups mixed agarose with buffer; boiled on hot plates; cooled; poured gels. Enzyme work started by one or two members of group and joined by others while gels cooled. Teacher often moved gels to storage. Recommend teacher make an extra 10-20% gels to replace those that break.

DAY 5: Load and run gels; Concept Questions Part 1. 70-minute period gave enough time to complete run. Gels stained overnight by teacher.

DAY 6: Analyze gels – estimate band lengths; record data. No semi-log plots done.

Most students unfamiliar with semi-log plots – needed at least 1.5 days to cover plots and standard line.

DAY 7: Concept Questions – Part 2, Vocab. Renew student interest with movie, "Animal's World." Students' emotional buy-in was flagging; movie rekindled interest.

DAY 8: Analyze Comstock data; compare students' and Comstock gels; determine outcome of ivory analysis.

Clarity of outcome depends greatly on quality of gel visualization with Carolina Blu™ dye. Be prepared for ambiguous data and uncertain similarities!

DAY 9: Review of Internet information; stakeholders' debate or directed discussion.

Be prepared to provide information that students did not find. Setting up a debate situation can add half a day to schedule. Directed discussion with non-judgmental questions that challenge students' positions can be equally effective.

HOMEWORK: Whale Assessment with sample handouts of whale meat articles. Can be followed up in class or simply evaluated as final project.

JENNIFER L. DUNCAN-TAYLOR

Port Angeles High School
304 E. Park Ave.
Port Angeles WA 98362
(206) 417-5191
taylorjd@olympus.net

18 years teaching high school, all in Port Angeles. 1,500 students at PAHS

Currently teaching four sections of Sophomore General Biology and one section of Advanced Placement Biology.

SEP participant in 1996.

Member of the SEP Elephant Project Curriculum Development Team for 2000-'02

With my high school science department colleagues, we have developed a curriculum that integrates 9-12 physical science, biology and chemistry and AP biology. It features principles of electricity, hydrolysis, ionization of molecules, pH, buffers, properties of matter and separation techniques. Electrophoresis features all of these principles, and students apply this technology in their sophomore year to separate DNA, their junior year to study molecules by doing SEP's Dye Lab, and their senior year in the High School Human Genome Project.

Outside of the classroom, I enjoy puttering in my pottery studio, painting, downhill skiing, sailing our boat and catching Dungeness crab. My husband and I also own and operate a lavender farm and gift shop in Sequim.

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PORT ANGELES HIGH SCHOOL
JENNIFER L. DUNCAN-TAYLOR

- 4 sections of Sophomore General Biology periods 1, 2, 5, 6
- 55 minute class periods
- 30-32 students per class
- 8 lab groups of 3 or 4 students

Before beginning the Elephant Project, students have completed DNA structure, replication, protein synthesis, genetics and have islolated DNA from plant tissue.
I use this project as a springboard to population genetics, changes in populations and ecology.

HOW I CUSTOMIZE THE ELEPHANT PROJECT FOR MY CLASSES:

Monday 55 min: Introduce the goals of the project, give info about Dr Comstock and Wasser and give students the Websearch assignment (which students have to do at home or in the library on their own). I give a brief discussion on restriction enzymes, palindromes and cutting DNA into pieces. The last 15 minutes of class we start the paper RFLP activity by cutting up elephant paragraphs—I draw the analogy that this is like isolating DNA into one big glob.

Tuesday 55 min: Students bring in their long strips of paper-DNA-elephant paragraphs and we do the RFLP activity. Much discussion—and I give them the assessment to do as homework.

After school, I arrange the room into 8 lab stations and prepare a color-coded lab tub for each station so I can refer to the "green group" "purple group" and so on. Every piece of equipment is also color coded for the lab station. Each tub includes: a micropipet, box of tips, microtube holder, ice cup, sharpie marking pen, waste-tip cup,

Wednesday 40 min: Learn how to use a micropipet and start the SEP activity with the food coloring on round filter papers. We only get through the placement of 3ul of each red, green, yellow and blue dots on the filter paper.

Thursday 55 min: Continue working with micropipets, and learn how to use the microcentrifuge by completing their four mixed colors and finishing their 3 ul dots on the filter paper. Also, I have poured "practice gels" with the combs in petri dishes, and I prepare a faux-loading buffer with blue food color and karo syrup and water. When students have finished their filter paper dots, then the flood the practice gel with water and practice how to load a sample in to the gel.

Friday 55 min: I demo the electrophoresis chamber and discuss charge, voltage, polarity, hydrolysis, pH, buffers. I use distilled water and start the power, then add a little salt water and start the power. Then I add phenol red for a pH indicator and run it for a few minutes (beautiful yellow and hot pink at the + and – poles respectively!) We talk about the dynamics of H+ and OH- ions, hydrolysis and pH. Then I pour in some TAE buffer and watch how the pH remains stable. I talk about the need to hold pH stable for the sake of DNA, and yet still be able to maintain charge to move the DNA.

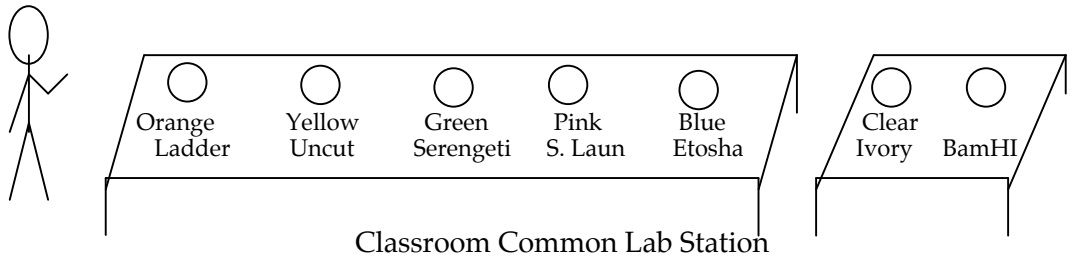
I allow time for students to get into groups and discuss how the web searches are going, share information and begin to talk about what the issues are about ivory trade.

Finally, students are given the protocol to the lab (see my "quick guide") and asked to draw a flow chart over the weekend.

On Friday after school: I remove the FHCRC DNA samples from the freezer and thaw them for just a few minutes and aliquot the samples into "class sets" as follows—then return them BACK TO THE FREEZER for Monday.

30ul of each precut sample, ladder and uncut DNA for each class (each lab group needs 3ul, assuming you will have 8 lab groups, you need 24ul, and I recommend 30ul for each class). **NOTE:** You will need 32ul of "ivory" DNA for each class, and I recommend that you aliquot 40ul for each class since each lab group will need 4ul. I aliquot 15ul of REact Buffer in a single microtube for each class, and 12ul of BamHI enzyme for each class.

I set up a Common Lab Station by placing 7 bowls marked with the corresponding DNA sample (the DNA needs to be kept on ice throughout the class period). I also recommend using colored microtubes, using a different color for each national park. Students should have microtubes that correspond in color. For example:



Classroom Common Lab Station

Mark the aliquot samples as follows: "LADDER" (marker), "UNCUT DNA", DNA Sample I should be labeled the "SERENGETI", DNA Sample II should be labeled SOUTH LUANGWA, and DNA Sample III should be labeled "ETOSHA".

I prepare zip-lock baggies with microtubes of the 5 colors for each lab group (32 in all—8 groups per class, 4 classes).

Monday #2 55 min: LAB! I get a bucket of crushed ice and put the class set of tubes (that I did last Friday night) at the common lab stations. Each group will need a cup of ice as well. I lead a brief review about cutting DNA with enzymes, check their flow diagrams, and review the procedures with the entire class. At the end of class, we have "ivory" tubes in the incubator, and the rest are in the freezer. I put the "ivory" tubes in the freezer after an hour.

After school on Monday, I put an electrophoresis gel chamber and a vial of loading buffer at each lab station. I also prepare the running buffer solution.

Tuesday #2 55 min: Before school, I premix and heat agarose gel and hold it in a water bath. Periods 1 and 5 will pour their gels, thaw out their DNA samples, add loading buffer and spin, prepare their gel boxes with running buffer, load their DNA samples and start the power.

Periods 2 and 6 watch the Discovery Channel Elephant Film.

I stop the gels, slide them out into staining trays, stain and destain them. Then I put them in zip-lock baggies for tomorrow.

Wednesday #2 40 min: Periods 1 and 5 look at their gels, take measurements and fill in their data table.

Periods 2 and 6 pour gels, thaw out their DNA, add loading buffer and spin, prepare their gel boxes with running buffer, load their DNA samples and start power. Again, I stop the gels and do the staining for them.

Thursday #2 55 min: Periods 1 and 5 do their semi-log graph and begin to make comparisons between Comstock data and their data and look for possible matches with the ivory.

Periods 2 and 6 look at their gels, take measurements and fill in their data table.

Friday #2 55 min: Periods 1 and 5 watch the Elephant Video that the other classes saw on Tuesday.

Periods 2 and 6 do their semi-log graph and begin to make comparisons of Comstock data, their data and their ivory.

On Friday after school—I clean up, do kit inventory and return the kit to SEP on Saturday.

Monday #3 55 min: All classes continue their analysis of the data, look at maps share internet information and work on their Concept Questions. I also have the students do a formal lab write-up and do the "Submission Form." We wrap up with a discussion about laws, exporting and whether or not Grandma and Grandpa are in trouble legally.

As of yet, I have not fit it the ethical dilemma activities, but I do use the final assessment using DNA to identify Whales or Lynx. Other places I have assessed students in this project were their micropipetting skills, lab flow chart and formal lab write up.

Elephant DNA & Ivory Analysis
Lab Protocol–Quick Guide

	First Day of Lab	Second Day of Lab
Student #1	Label all tubes: period and group color Pipet 10.5ul of sterile H2O into each tube, EXCEPT put only 8.5ul into the white "ivory" tube. **No need to change tips each time.	Get the gel box, comb and set it up with the rubber gaskets sealed. Pour the warm gel so that it comes us 1/3 up the teeth of the comb. When the gel is ready and your partners have finished preparing the samples, you will load 15 ul of LADDER and the UNCUT samples in to the gel.
Student #2	After student #1 has finished, bring all tubes to the Common Lab Station, keep them on ice. Use the ultra-micropipet and tiny tips to add 1.5ul React Buffer to all six tubes. **No need to change the tip each time.	Work with student #1 to prepare gel. After gel is set, lift out tray and rotate it so the comb is on the negative (black) end. Pour 600+ml running buffer into chamber and make sure all "gel peaks" are submerged. When students #3 &#4 have the samples ready, you will load 15ul of SERENGETI and S. LUANGWA samples in to the gel.
Student #3	After student #2 has finished, bring all tubes, your yellow tips and your p2/20 micropipet to the Common Lab Station. Keep tubes iced. Add 3ul of DNA from the assigned source into each of the tubes. KEEP THEM STRAIGHT!! Add 4ul of the ivory DNA to the white tube. **CHANGE TIPS EACH TIME.	While students #1 & #2 are preparing the gel, get your groups tubes out of the freezer and let them thaw. Add 3ul of Loading Buffer in to each tube. **CHANGE THE TIP EACH TIME. After your partners have loaded the samples, you will hook up the power, clean up and inventory your groups tub supplies. Throw out all tips and used tubes.
Student #4	Help student #3 load DNA samples. Close all tubes except the "ivory" and use the ultramicropipet and tiny tips to add 1ul of BamHI enzyme to just the "ivory" sample. Close the top, centrifuge all six tubes. Put the "ivory" tube in the incubator, and the rest in the freezer.	While students #1&#2 are making the gel, and student #3 is preparing the sample: prepare a sketch "plan" of which order the samples will be loaded into the gel.After student #3 has added loading buffer, will mix them in the centrifuge for 10 sec. You will loat 15 ul of ETOSHA and the IVORY samples into the gel.

NOTE: For one class period we were cramped for time because of a pep assembly—I poured the gels and added running buffer for them before they came in to class, so that all they had to do was add loading buffer, spin and load samples into the gel.

MIKE H. FELLOWS

Lakewood High School
Lakewood School District #306
P.O. Box 10
Lakewood, WA 98259
Thefellows3@cs.com

I have taught for 14 years, all in Lakewood. At one time or another, I've taught all of the science courses offered in Lakewood for 7th – 12th grades.

The courses that I currently teach are: Biology (10th grade), Chemistry (11th and 12th grades), and Advanced Biology: Forensics (11th and 12th grades). I have also designed an Adv. Bio: Ecology course and an Adv. Bio: Animal Behavior course.

I have been a member of the SEP learning community since 1997, as a participant and as a lead teacher for the summer teacher program. I have also been a member of the SEP Elephant Project Curriculum Development Team 2000-2002 .

Some of my special educational interests include: Forensics, Ecology, Evolution, Human Anatomy and Physiology, and Molecular Biology.

Some of my hobbies include: reading, photography, collecting old books and baseball cards, backpacking, collecting scientific and/or humorous T-shirts, and watching my son play soccer and baseball.

- 5 sections of Sophomore General Biology, periods 1,2,3,5,6
- 55 minute class periods
- 28-32 students per class
- 7 lab groups of 4 to 5 students

I insert the Elephant Project into my genetics unit, so the students have already learned about DNA structure, replication, and protein synthesis. The genetics unit is usually in late November-early December. The Elephant Project lasts approximately two weeks of the five-week genetics unit.

HOW I CUSTOMIZE THE ELEPHANT PROJECT FOR MY CLASSES:

Prerequisites

Day 1 – Micropipet Instructions and Practice
Day 2 – Electrophoresis Basics
Day 3/4 – Dye/Indicator Lab (alternate classes)
Day 3/4 – Human Genetics Activity

Engage

Day 5 – Scenario/Biographies/"Wildlife Warriors" Video/Nat. History

Explore

Day 6 – RFLP Paper Activity
Day 7 – "Ivory" Digest
Day 8/9 – Elephant RFLP Lab (alternate classes)

Explain

Day 8/9 – Analysis of Comstock and student data

Elaborate

Day 10 – Discussion of Scenario Conclusion and Bioethics

Evaluate

Day 11 – Whale Assessment

Specifics:

Day 1 – We go through how to use the micropipets properly and then I have the students practice by making the four microtube mixtures described in the Micropipetting Activity**.**

Day 2 – We go through the basics of gel electrophoresis by going over the handouts included in the kit, and I give them mental analogies to relate to (such as throwing two different sized rocks into a fast moving stream and seeing how the rocks "drop out" differently)

Day 3/4 – Several days before the Dye Lab I have my TA make the buffer and all of the gels for all of the classes. The gels can be stored in plastic sandwich bags in the refrigerator with a little buffer for a week or so. We alternate classes so that three classes (periods 1,3,6) do the lab first day, and the other classes (periods 2,5) do the lab the next day. I set up three stations of dyes (which I've aliquoted the day before from the stocks in the kit).

Day 3/4 – We do a fun Human Genetics Activity dealing with a variety of obvious traits.

Day 5 – We go through the scenario and background information about Kenine Comstock and Sam Wasser, including their mini-biographies. We watch the video "Wildlife Warriors", then go through the information on the natural history of the African elephant.

Day 6 – I explain the basics about restriction enzymes and RFLP's then we do the RFLP paper activity. I do the first version in which the students write their own sentences and then cut them up into fragments.

Day 7 – A few days prior to the "Ivory" digest, I set up 7 lab stations with enough materials in each tube for all five classes (with a little extra). There are three tubes that each lab group uses: I ("ivory" DNA), B (buffer and water), and RE (restriction enzyme). These three tubes are kept in a styrofoam cup with ice, which is replaced in the freezer after each class period. Each lab group labels their digest tube with a number and a letter: the number represents the period and the letter represents the lab group/bench. I pull the tubes out of the water bath later, and then put them into the freezer overnight.

Day 8/9 - Several days before the Elephant RFLP Lab I have my TA make the buffer and all of the gels for all of the classes. The gels can be stored in plastic sandwich bags in the refrigerator with a little buffer for a week or so. We alternate classes similar to the Dye Lab. I aliquot all of the DNA samples and loading buffer into 4 sets/lab stations, so that each station has enough materials for 2 lab groups in each of the 5 classes (with a little extra). The students load and run the gels, then start staining them. I finish the staining and destaining later, and then store the gels in the refrigerator overnight.

Day 8/9 - We use option 2 for analyzing both the Comstock data and the students' data. The students make their acetates from their gels, then use them to estimate the base pair lengths of the bands. Then they determine which of the banding patterns match. They turn in their Data Submission Forms before they leave.

Day 10 – Although the students walked away from Day 9 with the knowledge of where the "ivory" DNA came from, we talk about the potential outcomes for grandpa and grandma. Then we broaden the discussion to include more global issues involving the African elephant.

Day 11 – The students are given the Whale Assessment to determine how well they learned the material, and how well they could transfer their learning.

TRACY A. STOOPS

Shorewood High School
Shoreline School District
17300 Fremont Ave. N.
Shoreline, WA 98133
tracy.stoops@shorelineschools.org

I have been teaching for eleven years at Shorewood High School. Shorewood has approximately 1800 students and serves grades 9 through 12.

My most recent teaching assignments have included teaching General Biology, grades 10 – 12, Biotechnology grades 11 – 12, and Marine Biology grades 11- 12.

It has been an eventful 10 years. Developing science teams at the ninth and tenth grade level, coming to a teaching consensus on new curriculum for both, beginning a Marine Biology course with numerous field trips and an outreach component accessible to elementary students, and creating a vocational Biotechnology course. Of those experiences, the Biotechnology course has been by far the most challenging. Coordination between scientists, community members and higher education institutions has been a necessary part of that course development as well as maintaining a vocational teaching credential and fulfilling vocational curriculum components. Beginning a new lab, I have discovered, is both invigorating and exhausting but well worth the effort considering what students and staff gain from the connections, experiences and exchanges of creative ideas!

My connection with SEP began about 7 years ago as a participant in the SEP program. My mentor teacher was Janet Miriam at the Quality Control lab for Immunex located in Bothell. It rapidly grew into a lifeline for my teaching as I explored opening up the Biotechnology lab and sought help for curriculum, equipment, reagents and the technical expertise necessary to start a high school biotechnology program. Today I continue to be involved with SEP as a lead teacher and have recently completed work on the Elephant Project, a new piece of curriculum developed for the SEP kit program.

I enjoy snow skiing, swimming, bike riding, hiking and occasionally gardening (not really, only if it's a nice day and there aren't to many weeds!).

SHOREWOOD HIGH SCHOOL
SHORELINE PUBLIC SCHOOLS
TRACY A. STOOPS

- 3 sections of General Biology, grades 10 - 12
- 100 minute class periods twice a week, 55-minute period once a week
- 30 – 32 students per class
- 8 lab groups of 3 or 4 students

Before beginning the Elephant Project, students have completed their year of study on various Biology topics including units on biomolecules, ecology, DNA structure, protein synthesis, genetics, population genetics, ethics and evolution. In addition they are instructed on the use of micropipets and gel boxes prior to running this lab. The elephant project is used as a culminating project for the year and as an end of the year assessment. It requires students to use previously acquired knowledge to solve a new problem and explore the different ways biotechnology can be used as a tool. In addition, most of my students have just completed a unit on the geography of Africa in their World Geography class and this provides another conduit to connect students learning across the subject areas.

HOW I CUSTOMIZE THE ELEPHANT PROJECT FOR MY CLASSES:

Prerequisites

Day 1 -Micropipet Instructions and Practice Electrophoresis Basics

Engage

Day 2– Scenario/Biographies/Nat. History

Explore

Day 2 – RFLP Paper Activity

Day 3– "Ivory" Digest

Day 3 – Elephant RFLP Lab

Engage

Day 4 – Wild life Warrior Video

Elaborate

Day 4 - Modified ethics writing

Explore

Day 5 – Complete gel electrophoresis on the Elephant RFLP Lab

Explain

Day 6 - Analysis of Comstock and student data

Evaluate

Day 7 – Whale Assessment

<u>Specifics</u>

Day 1 (100 minutes)– The first two pages of the Micropipet lab were completed, stopping just before the centrifuge explanation. Students were proficient enough at selecting, reading

and setting micropipets to work independently or in groups without teacher instruction for the last part (pipetting onto parafilm). This is key to moving on to the scenario and lab. In addition page one of the Electrophoresis Exploration was completed. This allowed students to label the gel boxes, state the parts and review the purpose of the parts in a teacher led discussion. In addition, we simply put distilled water in the boxes and looked at the milliamp and vs. volt readings, then added 1 milliliter 50X TAE and rechecked milliamp vs., volt readings. A discussion followed about electric current and conductivity within the gel box. This saved time, as both labs were shortened to just the essential components and the first day was spent simply getting lab techniques and procedure skills in place.

Day 2 (100 minutes) – The scenario was read, the project introduced. Brainstorming was done on how DNA is used for identification and what information would be required to identify the source of the ivory. The Comstock and Wasser overheads were shown and discussed. Ivory samples and the elephant tooth were examined by students, with a high interest in discussing what part of the tusk is used by poachers and why the elephants are destroyed in order to obtain the ivory. We began the RFLP lab, and completed both paragraphs from option 2 on the RFLP activity. At the very end of the period, the first 8 minutes of the Discovery video was shown to peak interest in elephants – it worked!

Day 3 (100 minutes) - Prepared Samples and the Enzyme Digest. To again save time, the DNA for all samples was previously pipetted into color-coded tubes; (this can be done by the teacher OR by a student(s) proficient in micropipetting such as a TA or advanced class of students. In my case, biotechnology students helped here) A chart was made and put on the overhead to indicate to students how to associate the different color tubes to the DNA that they now contained as well as a tube number. Students in the class copied the information off the board and labeled all their tubes with the proper number and lab team identification. The students then pipetted the restriction buffer and the sterile water into the appropriate tubes containing the DNA and one student from each group came to the teacher to have the enzyme placed in tube 6 for the ivory digest. When all tubes were loaded, students centrifuged their set and placed tube6, the ivory digest tube into the 37 degree water bath. This method of set up met with tremendous success. It saved time, increased accuracy, wasted few reagents and still required each student to read the procedure, following directions, work as a team, and use their knew skills of micropipetting and centrifuging. By having the DNA and the enzyme under teacher control no reagents were wasted or contaminated. The total time for set up was around 40 minutes, when all groups' tubes were in the water bath; we reviewed Concept Questions Part 1. This allowed for classroom discussion, as not all answers are obvious to students in the student lab and some need to be thought through either in lab groups or in a whole class discussion. Also, this saved on making copies, as the lab protocols stayed at the lab tables for the next class. At the end of the period following the 30 minute incubation, lab groups brought there 6 tubes to the front of the room to put in a common rack for that class and to be placed in the freezer until they were ready to run the gel. If time permits, it is a good idea to run another 8 to 10 minute segment of the Discovery video to keep their interest in the bigger picture of the problem they are trying to solve.

Day 4 (time varied – some classes were 55 minutes others were 100) I was absent these days – it is good to keep in mind what else you have on your plate and schedule your movies accordingly! I showed "Wildlife Warrior" in its entirety to all classes. Those students who were in the longer class periods did an extension on this activity, which I borrowed from the ethics, activity in the Elephant Project. These students chose a stakeholder portrayed in the video (poacher, wildlife biologist, politician, ivory trader, ivory consumer, etc) and wrote a paper based on that stakeholders point of view on what they feel should be the consequences for Grandpa and his ivory purchase and why.

Day 5 (100 minutes)– I prepared the gel prior to class and kept it liquid at 60 degrees C. Students poured their own gels, coming to the water bath with a 25-ml beaker to receive the gel and Carolina Blu stain. While they set, instructions were given on preparing the gel box, adding the Sample Loading Buffer to their tubes, and on how to most easily load the wells. Each student was required to load at least one well for his or her lab team. (This took approximately 40 minutes) While the electrophoresis gel was running, students answered Concept 2 Questions and the Vocabulary List definitions were filled in. Again, this took time and was best done in lab team groups or as a whole class discussion. The gel ran for 45 minutes. At the end of the run, gels were put in a staining tray, labeled and left on the back counter for the teacher to stain with Carolina Blu. (I stained the gels immediately following class)

Day 6 (100 minutes) – Results from the gel were obtained and traced onto acetate sheets. These sheets and the Comstock data table were both analyzed by estimating the size of the bands as well as the number of bands observed. Students who ran their gels for less then 45 minutes got poor separation and hence it was more difficult for them to read their results, but the vast majority correctly identified the proper source. It did strengthen the idea that a database is crucial for scientific investigation and the mapping portion of the analysis questions enabled students to combine their world geography information and their scientific information - a great connection! I did not to do the semi log graphing option for analysis of data due to time constraints as well as math skills for the bulk of my students.

Day 7 – (22 minutes – the last day of school!) I was going to have students answer 1 or 2 questions from the whale assessment piece. However, being the last day of school, with some fairly exhausted and excited students and due to time constraints, I chose to discuss the assessment question. The assessment question I focused on was how scientists can provide evidence that a piece of whale meat found on fishing vessel is from a whale that can be legally harvested. This led to how can biotechnology be used to conserve ANY species.

SHERRY STUBER

Bellevue Public Schools
Sammamish High School
100 140th Ave.S.E.
Bellevue, Washington 98005
stubers@bds405.com

I have taught high school students, the art of problem solving, for the last 29 years. The curriculum topics range from general science, human biology, marine biology, biology to advanced biology, honors biology and for the past 11 years Advanced Placement Biology. In 1997 the Bellevue School District began to redefine and align the district science curriculum with the state ELAR's. The goal was to form an articulated science curriculum through the district, K-12. I have been a member of that district team from the beginning. We are in the process of articulation at all levels. I am a member of the high school science component of this project. I have been a Lesson Study Leader in the district for 2000 –02 and received a "Blue Ribbon" award in 2001 for the "What is a Buffer?" lesson study. It was designed and taught by myself and Bill Palmer to a combined AP Biology /AP Chemistry classroom. What can I say? Teaching defines my life. I have never wanted to do anything else. Each day presents a series of new challenges that make getting up and going to work an adventure.

I have been part of the SEP learning community from the beginning (1991). I have been a Lead Teacher (1997-2000), HutchLab Instructor (1999-2003) and a member of the Elephant project curriculum development team for these past two years.

When I am not teaching, I hike, roller blade, bike ride, jog, cross country ski, train a Chesapeake Bay retriever, grow roses and vegetables, remodel bathrooms and kitchens, oh…and sleep!

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- 12 sections of 9th/10th Biology, three teachers, team taught.
- 1 year of Biology is taught in a 1 semester block of 90minutes.
- Each Wednesday is a 60 minute time frame.
- We teach the full curriculum twice during the year.
- 28-30 students per class.
- 1st semester is a combination of 9th/10.
- 2nd semester is a 9th honors track.

Before beginning the Elephant Project, students have completed their year of study on various Biology topics including units on biomolecules, ecology, DNA structure, protein synthesis, genetics, population genetics, natural selection and evolution. The elephant project is used as a culminating project for the year and as an end of the year assessment. It requires students to use previously acquired knowledge and explore the different ways biotechnology can be applied to solve a problem and help save and endangered species.

HOW I CUSTOMIZE THE ELEPHANT PROJECT FOR MY CLASSROOOM.

- Previous to the Elephant Project our students have done the SEP Dye Lab. They know how to pour a gel, and have explored the principles of electrophoresis for the separation of molecules. They have been introduced to restriction enzymes and "sticky end cuts" through work with the BioRad PGLO" transformation lab. The Elephant Project is the second opportunity to reinforce these concepts and apply them to another aspect of biotechnology.
- Because our classes are 8 sections one semester and 4 sections the second semester, we choose to label and aliquot all of the simulated elephant DNA samples into micro-centrifuge tubes. The students then add solutions to these samples. This saves on student pipetting errors and helps insure a potential "good gel" for analysis.
- Our TA's or we, the teachers, do the aliquoting. It may require as many as 64 micro-centrifuge tubes (8 sections x 8 lab groups) per DNA sample. The tubes are labeled by park samples.
- We create 8 React 3 " buffer tubes, 8 sterile water tubes and 8 Loading Buffer tubes per room.
- We also have the Ivory DNA sample aliqouted for the enzyme digest by the student's lab teams. You will find a sample of that protocol in this folder. (SHS 3rd Enzyme Digest)

Lesson Flow

The day before we start the Elephant Project, the students read two sections in their Biology text (Modern Biology ed. 1999, Holt) on restriction enzymes, RFLP 's and biotechnology.

Day 1 (90 minutes) ENGAGE

Place "How Can Biotechnology be Used to Save andEndangered Species?" on the board for the theme of the unit. I let the students know that at the end of the unit I will be asking them to tell me "how biotechnology can be used to save an endangered species?"

Show 10 minutes of National Geographic "Wildlife Warriors". Ask the students to identify the issues surrounding poaching. Ask the question "How can Biotechnology be used to Save an Endangered Species?

In order to answer this question we need to develop some lab skills first. Micropipetting is one of those skills: 55 minutes of learning how to use the tools and practice of that skill with an evaluation of the skill by students creating micro-centrifuge tubes with set volumes that they pass to a partner to see if the partner can pipette the same volume they have identified.

While all of this is going on: assign members of the lab team to be an expert on:

Gel pouring and Electrophoresis box set up

Power supply and the running of the gel

Loading of the wells and correct micropipetting

Sample preparation and following of lab protocol.

Web search: for the current Laws and global regulations surrounding the trade of Ivory.

Do a quick run through on the responsibilities for the gel expert and the power supply expert. Students are then ready on the day of the lab to jump right in without a reminder.

Homework:

Read the "Natural History of the Elephant".

Flowchart the Enzyme digest in their journal .

Give students the map of Africa with the countries.

Day 2 (90 minutes) ENGAGE/EXPLORE

Open with 5-10 minutes of the Discovery Video: An Animals World: African Elephant (1st segment).

Read the Grandparents Scenario. What do scientists need to know and do next to find out where this Ivory came from? Short brainstorming, make a list on the overhead. (need DNA, need RFLP pattern that can distinguish a population one from another, need a data base of populations RFLP etc.)

Share the work of Dr. Wasser and Dr. Comstock. (Show color over heads)

One of the skills we need is an understanding of what an RFLP is and how it is created in the lab. Do RFLP Paper Activity: Alternate Activity (with the printed paragraphs about elephants) This simulates an enzyme digest of a population with RFLP's.

Quick clean up of paper. Review enzyme digest protocol (this was HW from the night before). Return to the lab and do the digest of the Ivory DNA by BamHI. Leave in the water bath overnight or if this is a Friday, remove and spin down, place in the freezer.

Quick summary of where we are, what we have done and what will happen next. Review the responsibilities of the experts in each lab team.

Homework:

RFLP assessment

Read and Flow chart the lab instructions into the student lab journal for the next day's lab (for us, this was a weekend. We set up the electrophoresis equipment before we left school on that Friday. All of the lab solutions had been aliquoted previous to this day.)

Day 3 (90 minutes) EXPLORE

Lab: Do the Elephant RFLP simulation …GO

Pour the gel, prepare the samples, load the gel, run for 45 minutes. It will take 30 to 40 minutes for students to have their gels loaded and running.

We used the AP Biology students through out the day to help each general biology lab team prepare their samples and load the gels.

All of the biology teaching staff (3 of us) gave up their prep period to be the second teacher in the room to help with whatever needed to be done. At the end of class, the second teacher helped with the gels, breaking down the box, staining the gels, de-staining the gels and setting up the box up for the next class.

This was a long and very stressful day. We were on our feet from 6:30am to 4:30PM. We were tired. We chose to do it this way because we wanted to keep all of the biology sections together. We have a limited time frame with which to accomplish this at the end of our semester year.

While the gels are running: work on the Comstock Data/Option 1: semi-log graph of Elephant RFLP Data for a database. Students were given this lab sheet as they left the lab room. They were to read the first two pages and then to work on their Concept Questions Part 1/2 in their lab teams. When all teams are done we worked as a group to learn how to plot a standard Ladder on semi-log graph paper. Also we identify the parks on the maps that were given to the students on Day 2. (see OH of African parks and OH of African map vegetation)

Homework:

Concept Questions Part 1 and 2.

Review the lab and predict what you might see on your gel tomorrow.

Day 4 (90 minute) EXPLAIN

Open class with 10 minutes of Discovery Video: An Animals World: African Elephant. (next segment or choose a segment that you like)

Review the semi-log plot for the Comstock Data.

Continue on with how to use the standard curve as a tool to identify the bp sizes of the RFLP bands. Continue with the analysis of the Comstock Data. Teacher functions as facilitator/students in lab teams.

At some point, the class has to move to the analysis of their own gels. It has been my experience (having taught this unit 4 times to 9th and 10 grade minds) students take some time to grasp the concepts presented in the lab. I allow enough time to get the majority of the class on the same page and then move to the next step. As an opening activity on the next day we will review the main concepts again. The goal is to reach more students each time.

Analysis of our own gel:

Return to the lab room look at the gel and compare it to your prediction in your journal.

Place the gel in a ziplock baggie, label the baggie with team names and date.

Place the gel on a light box, trace the wells and bands on to an acetate sheet. Do this 3 times so that each team member has a copy that they paste into their own journal. We have three light boxes. You can speed up the process by dong one tracing on the light box and then the others from the master copy.

Return to the front of the classroom. Finish the Comstock Data and move to the analysis of your gel and data. See Analysis of Student Data/Comparison of Patterns and Data Submission Form DS 571. We spend time as a group locating the biomes (vegetation) on the student maps. (See the OH of the African Maps)

What is the source of the Ivory? Is Grandpa in trouble?

Homework:

"Finish all the concept questions, be sure that your have completed the lab and questions for both the Comstock Data analysis and the analysis of your gel. Review your lab procedure: What did you do and Why?"

"We will open class tomorrow with the final summary of the lab. We will discuss the of the fate of Grandpa and the African Elephant, so Web experts be ready with data to back up your statements."

Day 5 (60 minute) ELABORATE

Open with a BIG summary of this lab and why we did what we did. This involves students asking questions around the Concept Questions: part 1 and 2 along with the vocabulary.

Show another segment on poaching from the National Geographic Video: Wildlife Warriors.

Class discussion of the issues and the source of the Ivory: I let each lab team have time to tale with the web expert to be sure that they understand the current laws and regulations. If the web expert does not have data to share I have several web pages "book marked" for them to use.

Conclude by asking the question: How can Biotechnology be used to Save an Endangered Species? Students should be able to summarize this in verbal form or in their journal. They should also be able to ELABORATE on the current issues surrounding the ivory trade and the current laws that govern this global issue.

Homework

Study for the assessment tomorrow. Be sure to look over the lab and the Concept Questions.

Day 6 (40 minutes of a 90 minute class) EVALUATE