Lesson Plan Template

Introduction to Heredity
Grade Level: 10
Prepared by: Antoinette Linton

Section 1: Lesson Summary
Topic

NGSS Performance Expectation:
Students will be able to ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population

NGSS Performance Expectation (Unwrap)

Blooms	DOK	Skills (Verb)	Concepts (Noun)
Application 3* Students ask questions about relationships between DNA and chromosomes and inheritance when they write an argument and write their text study	Explain the steps 2* Level 2 (specify and explain relationships between DNA, Chromosomes, phenotype and inheritance) Level 3 when they engage in the experimentation process to investigate DNA extraction, meiosis modeling, pedagogy making and probability of expressions.	Students will construct an argument. Analyze different sources of evidence (Henrietta lacks document, Genetic Dilemma, etc).	Understanding the sources of genetic variation in a population, Understanding how genes are changed in living organisms, understanding how we use genetic engineering in our food and how we understand it in our families/populations (pedigree).

California State Standards

California State Standard (Unwrap)

Bloom	DOK	Skills (Verb)	Concepts (Noun)

Identify the most applicable Crosscutting Concept
Cause and Effect
Scale, Proportion, and Quanttity

Lesson Plan Template

Science is a human Endeavor
Objective of the Lesson or Unit: 1) Taken form the NGSS, students are to ask testable questions (KQHL) and design problems using models (DNA model) 2) Students apply the concepts of heredity elicited from the karyotype lab to the concept of cancer and the issues that stem from the Henrietta Lack's case.
Culminating Assessment (How will you know students have met the Performance Expectation?)Describe the assessment and attach a copy. **The culminating task will have two parts:** 1. KQHL of the DNA extraction Lab and the Karyotyping Lab 2. Assessment
What has been taught in my class to prepare students for this topic? Students have learned the following processes 1) Text-study process with rubric 2) Laboratory/experimentation process with rubric 3) Concept mapping process Student prior knowledge includes The structure and function of DNA (the basic biochemical components) Macromolecule information
Description of the Lesson/Unit (Use the following Table)

5E	Short description of activity	Purpose/Intention for the activity or Key Learning
Engage	Opening the unit with a culturally meaningful discussion about HELA cells	Building a conceptual map based on the Priority vocabulary and major classroom consensus about the importance of biomedical research.
Explore	Text-study of HeLa cells from the Smithsonian.com article: "*Cracking the Code of the Human Genome"* Genetic Dilemma Reading DNA Extraction Laboratory (Genetically Modification of Bananas).	Students read the HeLa cells reading to develop a classroom consensus about the limits of genetic research. There is an overall focus of cancer due to its connection to 1) connections to mutations coded within the genome of indviiduals 2) cancer being passed on from parent to offspring

		Students will refine their argument about genetic modification in light of the following video: http://www.bozemanscience.com/comparing-dna-sequences Guding questions: 1. How does this relate to the technique you did in the laboratory? 2. How could you have used some of the techniques presented to extend your argument? 3. If you are technique people (students who focused on technique and not DNA modification) how could you have determined whether your technique modification improved DNA extraction or introduced impurities?
Explain	DNA/Chromosome Model.	Students explain how DNA is the heredity molecule, how it is organized in chromosomes, and how these chromosomes are passed down from parent to offspring. Teacher helps connect students back to framework.
Elaborate	Bozeman Science Video	Students will watch the videos listed below and modify their text-study concerning Mendelian Genetics. Students may refine or add questions to **clarify relationships about the role of DNA and Chromosomes in coding the instructions for characteristics traits passed from parents to offspring.**
Evaluate	Assessments/KQHL	Students will be able to make claims about the causes of cancer and other genetic disorders, support these claims with evidence

Section Details:

Lesson Plan Template

Opening discussion: Controversy Surrounding HeLa:

Essential Question: Can hospitals and scientists use our tissues, organs, or cells for research without our consent?

Better Essential Question (3/26/2014): What responsibility do we have as health care buyers, grocery store consumers, and community members to know the relevant information to determine if we are being exploited or if we are being taken care of by private and government institutions?

Scenario Opener: You are a community member here in Los Angeles and you will need to go to the hospital, buy food and be a part of a family either as a child of someone or a future parent of someone. You will need to make sophisticated judgments about the credibility of health, food, and welfare claims by the local city, state and national government agents (Like the FDA). As an informed community member (ESLR) you will need to design a rubric or criteria for judging the ethical practices of local, city and state agencies now that you will be a primary consumer of their services.

Task 1: You will learn about Henrietta Lack's and then create a criteria for judging future experiences with genetic testing, genetic modification, and predicting outcomes.

Task 2: Ask clarifying questions about the role of DNA and chromosomes in coding the instructions for characteristics traits passed from parents to offspring by creating a text-study and then isolate DNA.

Task 3: Learn how scientists compare DNA molecules of individuals within a species group and individuals outside of the species group and then elaborate on how the techniques studied could extend their understanding of the importance of DNA testing.

Opening up the lesson with a case study establishes a framework for analysis of heredity information. The statements in the Henrietta Lack's case provides enough information for the students to figure out personal/social/scientific solutions and then to identify how to apply those solutions in other similar situations. The issue ownership of DNA and the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. Henrietta Lack is interesting because there is something about her DNA that allows cells to be immortal. Her cells are abnormal in that they escape normal cell cycle controls. These controls are DNA controlled and there are mutations in her DNA that scientists are very interested in.

There is no requirement to inform a patient or their relatives about bodily material obtained during surgery, diagnosis, or therapy. The HeLa cell line sparked a 1950s debate on medical ethics because the HeLa cells were propagated, and later commercialized to a great extent, without the knowledge or permission of Lacks or her family. In fact, the HeLa cell line's sheer ubiquity is how Henrietta Lacks' family, far removed from the field of scientific research, came to know about it 24 years after the death of Henrietta Lacks.

Continuing Discussion: DNA Extraction and Bozeman Science Videos

Students are to construct research questions based on the case study reading, the textbook and the laboratory protocols. An emphasis was made to have students connect the idea of genetic testing and modification to testable questions that could be posed in the laboratory. Students will have difficulty with this concept at first. It is imperative that we provide examples and correct mistakes in a way that still facilitates students curiosity and intellectual resilience. I found that it was impactful that students try, have one-on-one time with me, and we have a discussion where the distinction is made between a *testable* question. For example, a students designed a laboratory experiment where he tested whether or not the bananas were bacterial resistant as an indicator of genetic modification. He introduced bacteria to one slice of banana and left another banana unaltered. Another student

wanted to make physical observations of DNA from an organic banana and a "regular" banana. These experimental set ups were constructed from discussions students had with me and the testability of their research questions.

The Bozeman science video on comparing dna sequences helps me as a teacher explain the possible usages of dna extraction. Here DNA extraction is a "first step" of analysis. I stretch the concept further by brining up the idea that there are different kinds of DNA found in the fruit (nuclear, mitochondrial, and chloroplast). If we wanted to, we could research strands of each DNA and compare the strands to each other and other types of organisms. Students needed a great deal of scaffolding for this portion of the argumentation process.

Section 2: Laboratory/ First-hand Approximation of Practice Lesson (From Explore, Elaborate, or Evaluate phase of the 5E Learning Cycle)

The laboratory activities that are included in this lesson are as follows:
DNA extraction (KQHL)
Karyotyping Activity (KQHL)

Assessment: How will I know students met the objective?

Students will be able to pose questions on both KQHL documents concerning the modification and organization of DNA and chromosomes. The "Q" portion of the DNA extraction laboratory activity was facilitated by using information from Mendelian genetics, information about the structure and function of DNA, and information read from the "Genetics Dilemma" case study. Second, students completed the "H" portion of the KQHL by converting one of the "Q" questions into a hypothesis written in the "if..then" format and then tested it by either following the DNA extraction protocol or by extending the protocol to include testable steps. Students report their observations and formulate an argument that either supports or rejects their hypotheses.

Rubric:
See laboratory rubric

Description of lesson: Students were assigned text-study concerning Mendel's pea plant experiments where they developed key concept questions, reviewed the methods presented in the text and reflected on the organization and findings from the historical laboratory procedures.

3. Students reviewed the Genetic Dilemma text to begin discussions about genetic modified food, the FDA and whether the FDA is following the criteria students constructed from the HeLa reading earlier in this lesson.
4. From the text study and the reading of the Genetic Dilemma case, students highlighted what they knew about the readings and placed it in the "k" portion of the lab.
5. Students then construct questions from the premises of the readings, and are encouraged to make connections from the previous readings.
6. Students then choose a question from the list convert to a hypothesis and procede to make any modifications to the laboratory protocol to test the hypothesis.
7. Students observe the data, answer the questions, and then formulate an argument as they complete the KQHL.

Lesson Plan Template

Time required for the lesson: one week
Materials/ Preparation needed: DNA extraction lab Karyotyping activity KQHL Rubrics Concept maps

Description of Student Task (each step)	Time Needed for Students to complete each Task	Teacher Notes (Include strategies/questions to check for understanding)	Accommodation/Modification for Student Access and Extension (i.e. strategies for EL and extensions for GATE)
Warm-ups as (engagement)	5 minutes/ period	Students are encouraged to use their previous ideas about the topic, the text book and the concept map to develop an understanding of the topic for the week.	Students need to hear and see the expectations of the readings. Often times during this time of year the students will not answer the question correctly because they will go through the assignment quickly. It helps to have the students paraphrase the answers and that we ask clarifying questions of the whole class, small groups, and individual students to facilitate concept development.
Concept map and vocabulary development	15 minutes	Students write the concept map down and use the tool to familiarize themselves with the vocabulary.	
Reading Cases/Text Studies	35 minutes	Students use their concept map and vocabulary log in order to read the cases and	This is a good SAIDE strategy for students. They are looking for the priority vocabulary

		text-studies. The major answers to this question are used to guide the discussions of the unit.	works as well as keeping in mind the essential question for the unit. For the Henrietta Lacks discussion the essential question was " do you think that hospitals and scientists should be able to use your tissues, cells and organs for research without your consent?"

Section 3: Science Literacy (From Explain, Elaborate, or Evaluate phase of the 5E Learning Cycle)

Content Objective: ELA Common Core Standard (E5) Read, write, and speak grounded in evidence; (E3) Obtain, synthesize, and report data clearly and effectively in response to task and purpose; Use technology & digital media strategically & capably Language Objective: Key CCSS Practice of ELA with embedded analytical tasks and receptive and productive language functions. For science this will focus on analytical tasks for the students at the secondary level. Students will analyze how ideas or events are transformed from one text to another. For receptive language functions students have systematically organized the text evidence in writing to support or reject their hypotheses. In addition the students include sufficient details and reasoning to extend their thinking.
Assessment: How will I know students met the objective? Case Study Reading Text-Study: Mendelian Genetics Text Study Argumentation for the experimentation process. Rubric: See the attachment.

Lesson Plan Template

Description of lesson: The text-study is an assignment where students advance their ideas about biology using biological text. Here students engage in a 6-step expository process where (1) they create research questions based on question frames, (2) infer the scientific practices presented in the text, (3) determine data sources, (4) analyze the text organizational features, (5) answer the research questions from the first step and (6) create a summary for the section assigned. The purpose of this assignment is to facilitate student understanding of how scientists have developed knowledge around the topic under study. In addition, students are to use the information from the text or video evidence to brainstorm their own research questions and methodologies for the experimentation process. The experimentation process includes a writing portion where students engage in a 5-step process that mirrors the text-study that includes a document called the KQHL. The KQHL is likened to the KWL but there are significant changes. First, students work together in research groups where they highlight the background information of the laboratory activity. For this lesson the background information is the Henrietta Lacks case study, the text-study on Mendelian genetics and the case titled the "Genetic Dilemma." These texts are used to facilitate a discussion onw hat students already know and they place it under the "K" portion. Second, students use the same question frames from the text-study assignment to formulate 5 research questions that can be used to create hypotheses. They hypotheses are possible answers to research questions and are testable. Next, students set up their laboratory activity according to the hypotheses that will be tests, collect their data and the organize the data for analysis. It is the analysis portion that is most important to this section. Here students engage in a 3-step argumentation process where students restate their hypotheses, provide evidence from the laboratory to support or reject the hypotheses, and then draw conclusions based on textual evidence from the learning experience.
Time required for the lesson: Two class periods
Materials/ Preparation needed: Boseman video District approved biology text Case Studies: Henrietta Lacks; Genetic Dilemma

Description of Student Task (each step)	Time Needed for Students to complete each Task	Teacher Notes (Include strategies/questions to check for understanding)	Accommodation/Modification for Student Access and Extension (i.e. strategies for EL and extensions for GATE)

Henrietta Lacks case study	30 minutes	Students will need highlighters and guiding questions	Graphic organizer for genetic concepts. Vocabulary log Time to discuss what they know about genetic testing Connection to historical events
Genetics Dilemma	30 minutes	Students need seed questions to engage in what they already know about "GMOs" and genetically processed food	Sounding out of words Hearing the science words read aloud
Text study	1 hour/homework & guided practice	Students need guiding ppt to know what to attend to while reading	Rubric for the text study Focus inquiry for text study KQL to know what to use when writing up the laboratory report.

Section 5: Reflection on Practice

After the DNA extraction laboratory students received an opportunity to see a Bozemanscience video on comparing dna sequences. This video was intended to introduce Blast technology to students and to extend their thinking about DNA and the like. In addition, I had the students tie back the discussion to the framework from the Henrietta Lacks activity as a component of the argument and the conclusion section of the laboratory write up. Students were aware that this part of the discussion was nor originally part of the argument process located on the back of the KQHL. Therefore, if I want to continue to tie back to the meaning making that I want students to have, based on their lived experience, then I have to do a *focus inquiry* and *directed observation* of the modified/refined process. *Focus inquiry* into the process for this example includes direct instruction on the parts of the graphic organizer that have been changed, opportunities for students to ask questions about what is expected of them when addressing this change, opportunities for students to give examples of what they might write in the sections, as well as looking at past work from other students and their own past work. *Directed observation* into the process includes an intentionally planned experience where students are directed to attend to specific changes of the process during a learning experience. They, along with me, work to meet the requirements of the planned experimentation process. So for the next laboratory experience (the Karyotyping lab next week) we will tie back to the framing that began the unit, refer back to the case study about mitosis, come up with research questions and a hypothesis, and go through

the karyotyping as laid out in the laboratory activity. Then when we engage in the argumentation process we will restate the hypothesis, support or reject the hypothesis according to the data, then we will tie back to the case study, to the text study that will be assigned next week, and to another one of bozemanscience.com video concerning karyotyping. This will be the textual evidence used to formulate the argument (which is connected to the common core state standards CCSS). We will then tie it all together by revisiting the framework from Henrietta Lacks text from week one. In this way I am building a cohesive and coherent unit of learning for the students that is based on a lived, valued, and relevant experience.

I am finding that students have tremendous difficulties with the processing needed to complete the learning experience independently. It seems that when there are new ideas presented by students and by me, then there is ALWAYS a need for focus inquiry. ALWAYS! I have to stop periodically and do this. In the future I will have to plan when and where focus inquiry into a new, modified, or refined process.

Students have stated that they feel "accomplished" at the end of the experimentation process. That in the past some students would give up on completing the text studies or the KQHL/experimentation process. There is a level of stick-to-it-ness that must be cultivated or students will experience failure/inferiority. According to Erik Erikson's theory of psychosocial development students may experience inferiority when they are not guided to develop a sense of pride in their accomplishments and abilities. This stage usually develops between the ages of 6 and 11, but if left unattended to students may begin to be their own worst enemies academically. Plus it is not an option for teachers to claim that "they should have developed this sense of academic self in middle school and that we don't have to create learning environments that nurture this sense of academic ability." Creating learning experiences where students can master new skills will facilitate a feeling of competence and belief in their skills. This is the basis of self-efficacy for my science classroom.

Focus Heredity: Week 2 Cancer and Genetic Disorders
Grade Level: 10
Prepared by: Antoinette Linton

Section 2: Lesson Summary
Topic

NGSS Performance Expectation: HS-LS1-4
Students will be able to use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms
HS-LS3
Students will explain how errors can occur during replication, and how mutations are caused by environmental factors.
NGSS Performance Expectation (Unwrap)

Lesson Plan Template

Blooms	DOK	Skills (Verb)	Concepts (Noun)
Understand Level 2 Students are asked to summarize results of the karyotyping, make basic inferences and logical predictions from data/observations. The karyotype is used as a model to present actual phenomena and determining chromosomal disorders	Skills and concepts Students construct the model and tie the model back to previous learning from the first learning experience. Students tie back to the case study and are required to translate the information from the reading to the skill of karyotyping.	Analyze: Students organize the chromosomes and interpret data from the organization.	Comes from the Cross-Cutting-Concepts and the DCI: To learn this concept students used models (karyotyping) to simulate how genes and information about how to grow and function according to the universal DNA code is passed down from one generation to another an dhow it involves a level of stability and conservation of the code to do this.

California State Standards

California State Standard (Unwrap)

Bloom	DOK	Skills (Verb)	Concepts (Noun)

Priority Vocabulary:
Diploid Mitosis
Haploid Chromosome
Karyotyping Chromatid
Polyploidy
Cell Cycle

Identify the most applicable Crosscutting Concept
Cause and Effect
Scale, Proportion, and Quantity
Science is a human Endeavor

Objective of the Lesson or Unit:

3) Taken form the NGSS, students are to ask testable questions (KQHL) and design problems using models (DNA model)
4) Students apply the concepts of heredity elicited from the karyotype lab to the concept of cancer and the issues that stem from the Henrietta Lack's case.

Lesson Plan Template

Culminating Assessment (How will you know students have met the Performance Expectation?)Describe the assessment and attach a copy.

The culminating task will have two parts:

8. Case Study Flow chart of Mitosis
9. KQHL of the Karyotyping Lab
10. Mitosis Activity
11. Performance Assessment

What has been taught in my class to prepare students for this topic?

Students have learned the following processes

4) Text-study process with rubric
5) Laboratory/experimentation process with rubric
6) Concept mapping process

Student prior knowledge includes

The structure and function of DNA (the basic biochemical components)

Macromolecule information

Description of the Lesson/Unit (Use the following Table)

5E	Short description of activity	Purpose/Intention for the activity or Key Learning In addition, a purposeful connection from the last learning experiences to the •
Engage	Opening the unit with a culturally meaningful discussion about HELA cells Case Study: **The case of the dividing cell: Mitosis and Meiosis in the Cellular Court Part I—the First Day of Testimony**	Building a conceptual map based on the Priority vocabulary and major classroom consensus about the importance of biomedical research. For the Case Study Students completed a flow chart based on the reading. This case study leads into the karyotyping laboratory activity because the students have to determine which karyotype is the result of the egg from the case study.
Explore	Text-Study 341, 349-353 *Human Heredity* *Cancer and causes 250-255* This is presented as a power point which has the criteria for the text study and the sections of the readings that students are	Students read the textbook reading to develop an understanding of chromosomal genetics in human beings. 3) Students will have to interpret the text-study on Human Heredity in light of the karyotyping laboratory.

	to attend to in order to complete the **argumentation** section of the experimentation process.	Specifically creating **research questions and hypotheses** 4) cancer being passed on from parent to offspring
Explain	DNA/Chromosome Model. Bozemanscience.com/mitosis video	Students explain how DNA is the heredity molecule, how it is organized in chromosomes, and how these chromosomes are passed down from parent to offspring. Teacher helps connect students back to framework. Guiding questions 1. What causes cancer? 2. What happens when the cell that has the gene for causing cancers is allowed to go into the M-phase of mitosis?
Elaborate	Karyotyping Laboratory activity Bozeman video LS3A-Inheritance of traits	Students will be able to determine what disorders were passed to offspring, what caused the disorder. Guiding questions 1. List three chromosomes that are carry the genes for cancer. 2. If you have this gene what environmental factors could cause cancer, mutate you chromosomes?
Evaluate	Assessments/KQHL	Students will be able to make claims about the causes of cancer and other genetic disorders, support these claims with evidence

Section Details:

Opening discussion: Case of the Dividing Cell: Mitosis and Meiosis Cellular Court

Lesson Plan Template

Part I—The First Day of Testimony

Essential Question: Can hospitals and scientists use our tissues, organs, or cells for research without our consent?

Better Essential Question (3/26/2014): What responsibility do we have as health care buyers, grocery store consumers, and community members to know the relevant information to determine if we are being exploited or if we are being taken care of by private and government institutions?

Scenario Extension: You are informed community members. You understand DNA and the role it plays in inheritance and the DNA components. Now you need to understand how geneticist determine information about human heredity by observing what normal cells do and what causes cells to behave abnormally. You will need to illustrate how the body uses the cell cycle to heal itself, what environmental agents in our community hinder the body from using its natural mechanisms of healing, and how we can tell if a person is more susceptible to these harmful agents.

Task 1: You will learn about the cell cycle and then illustrate the role the cell cycle plays in the healing process.

Task 2: You will research causes of cancer, different types of cancer and the inheritance patterns of genetic diseases and chromosomal abnormalities by creating a text-study.

Task 3: You will learn how to determine genetic disorders caused by polyploidy by constructing karyotypes and comparing them to normal individuals.

The second section of the unit opens up with Mitosis. This is important because students need to understand how cells reproduce themselves and how the cells maintain the appropriate number of chromosomes. The case study presents a number of concepts in a context in which students can readily understand. The idea that bacteria are prokaryotes and reproduce by binary fission. This is compared to eukaryotic division (cell cycle) where there are intricate steps in the cycle that students understand. By the end of the case study the students understand the difference between diploid and haploid, somatic cells and gametes, and that a liver cell (the first character on the stand) is a somatic cell, where the egg cell is haploid, the defendant in the case.

This case study is related to the cross cutting concept of Systems and System Models in that it contextualizes where the biochemistry of mitosis, the organization of karyotypes, and the analysis of the effects it has on cells and entire organisms happens. This case study can also be related to the case study from the first learning experience in that we can talk about how scientists know about cells, mitosis, chromosomes, and chromosome abnormalities from the research that was done from Henrietta Lacks' cells. The information that we received from taking her cells and studying them without her consent has improved our knowledge of science and biology. However, was it right? Like other similar incidences in time where one group of people are looked at and judged as less than, inferior and at times the scourge of the Earth, African Americans in this country are thought to not deserve the same high standards of treatment because of economic, cultural, and social differences. Because Henrietta Lack was a poor tobacco farmer it was completely OK not to inform her or give her or her descents compensation from the information received solely from her tissue and cells. Students can then make decisions about how far removed do we have to become I order not to take responsibility for what we have done in the past and how we benefit from it today.

Continuing Discussion: Karyotyping

Students are to construct research questions based on the case study reading, the textbook and the laboratory protocols. Students worked in groups of four or five to save time. Each student was responsible for a portion of the five karyotypes (normal, A, B, C, D, and E). Students were to determine what type of chromosomal disorder the karyotype possessed. This laboratory assignment will be the first to extend the argumentation process by explicitly

telling students to go back to the original case study on Henrietta Lacks or the Mitosis case study to conclude the assignment. The students are guided interpreting and making sense of the situations presented in the readings in light of the laboratory evidence. The work should be evaluated on the basis of quality of the argument, accuracy in representing what students feel about the work, and the conceptualization of the task (Hollins, 2008).

Section 2: Laboratory/ First-hand Approximation of Practice Lesson (From Explore, Elaborate, or Evaluate phase of the 5E Learning Cycle)

The laboratory activities that are included in this lesson are as follows:
DNA extraction (KQHL)
Karyotyping Activity (KQHL)

Assessment: How will I know students met the objective?

Students will be able to pose questions on the KQHL document concerning karyotyping, why we use karyotypes, how we make karyotypes and how this is connected to the overall ideas of genetic modification and the ethical issues concerning genetic testing. The "Q" portion of the Karyotyping laboratory activity was facilitated by using information from the text-study page 341-348 on Human Heredity, and information read from the laboratory. Students will be able to write down five items they already knew about chromosomes, genetic testing, and tracking genetic expression. The "Q" portion will have five testable questions related to the karyotyping laboratory. Sample questions can include: "*What can we learn by reading a karyotype?"* or "*How do we use karyotypes to determine chromosomal diseases?* Second, students completed the "H" portion of the KQHL by converting one of the "Q" questions into a hypothesis written in the "if..then" format and then tested it by creating the five karyotypes and comparing the types to the designated "normal" karyotype. Students report their observations and formulate an argument that either supports or rejects their hypotheses.

Rubric:
See laboratory rubric

Description of lesson:

12. Students reviewed the text-study from the lesson (explained in the science literacy portion of the lesson.
13. From the text study and the lab, students highlighted what they knew about the readings and placed it in the "k" portion of the lab. A point was made to interpret the information in light of the karyotyping lab. I wanted the students to review all the possible reading portions.
14. Students then construct questions from the premises of the readings, and are encouraged to make connections from the previous readings.
15. Students then choose a question from the list convert to a hypothesis and proceed to make any modifications to the laboratory protocol to test the hypothesis.
16. Students observe the data, answer the questions, and then formulate an argument as they complete the KQHL.
17. Students are encouraged to go back to the original Henrietta Lacks case study to conclude

their argument.
Time required for the lesson: one week
Materials/ Preparation needed: Karyotyping Laboratory Text-study pages 341-348 KQHL Rubrics Human Genome Landmarks Poster

Description of Student Task (each step)	Time Needed for Students to complete each Task	Teacher Notes (Include strategies/questions to check for understanding)	Accommodation/Modification for Student Access and Extension (i.e. strategies for EL and extensions for GATE)
Warm-ups as (engagement)	5 minutes/ period	Students are encouraged to use their previous ideas about the topic, the text book and the concept map to develop an understanding of the topic for the week.	During this lesson the students and I created a "*what we learnin"* process due to the fact that a review was not done after the warm-ups. Students are now given extra credit to develop a class consensus for what they are learning.
Reading of the Laboratory assignment	15 minutes	Students are given time to look over the lab. (*Focus Inquiry)*	Students examine the structure of the lab; review the directions, the laboratory rubric, and any samples that may be available from previous courses.
Laboratory completion	3 class periods	Students are assigned a specific karyotype to cut out and organized. Students are encouraged to do at least two karyotypes to be satisfactory for Data.	This is a good SAIDE strategy for students. They are looking for the priority vocabulary works as well as keeping in mind the essential question for the unit.

		Data analysis is an analysis of the five karyotypes according to the following criteria: Heading: ___ Number of Chromosomes__ What is the Sex? _____ Normal or Mutated? (circle) If mutated name the disorder below Students then are to answer their five research questions in the "L" portion of the KQHL	For the karyotyping laboratory activity included not so much switching and translation but an effort to make connections to students' lives to increase motivation, engagement and learning (English Learner Master Plan p. 91). Students were placed in cooperative groups where they were encouraged to motivate each other and work towards a common goal. The KQHL is used as an advanced Graphic Organizer.
Argumentation Process	1 class period	Students follow the prompts on the back of the KQHL where they restate their hypothesis, use the data to support or reject the hypothesis. Then the students use the text-study information to extend the concept of the lab experience. Lastly, they tie back to the original framework from the first week.	The argumentation is support through instructional conversations and the process that students engage in order to conclude the lab.

Section 3: Science Literacy (From Explain, Elaborate, or Evaluate phase of the 5E Learning Cycle)

Content Objective: Students will be able to cite specific textual evidence to support analysis of karyotyping and other genetics tests to determine human heredity. With the aid of the text-study aid students will be able to attend to important distinctions the author of the chapter makes and to the lab. Language Objective: Key CCSS Practice of ELA with embedded analytical tasks and receptive and productive language functions. For science this will focus on analytical tasks for the students at the secondary level.

Lesson Plan Template

Assessment: How will I know students met the objective? Case Study Reading: The Case of the Dividing Cell: Mitosis and Meiosis in the Cellular Court Part 1: The first day of testimony Text-Study: Human Heredity Students will be able to recognize the methods and data sources science used to study human heredity. Students are required to infer the scientific practices presented in the text, determine the data sources and make connections to their own laboratory work, analyze the text for organization features, answer their own research questions and create a summary of the section assigned. Students are able to use key features of their text study to support or reject their hypotheses from the karyotyping laboratory. Students are able to identify a genetic chromosomal disorder, make a claim about its significance with at least two pieces of evidence such as the disease that karyotype B has is sex-linked and the sex of the individual is male. Rubric:
Description of lesson: Students were assigned text-study concerning human heredity where they developed key concept questions, reviewed the methods presented in the text and reflected on the organization and findings from laboratory procedures in the field.
Time required for the lesson: 1 day (for homework)
Materials/ Preparation needed: Textbook page 341-348

Description of Student Task (each step)	Time Needed for Students to complete each Task	Teacher Notes (Include strategies/questions to check for understanding)	Accommodation/Modification for Student Access and Extension (i.e. strategies for EL and extensions for GATE)
Text-study	1 day (homework)	Students will need the powerpoint and focus inquiry into the key points that they	The construction of the text-study has been an all year process. At the beginning of

		will need to attend to.	the year students received focus inquiry and directed observation on how to do the assignment. As the year has progressed the students have received less and less scaffolding where now most students can do this assignment as homework.

Section 4: Student Pages

Please provide a printer/copier friendly student pages for Section 2 and Section 3.

Section 5: Reflection

Text-study activity

At the beginning of this learning experience I assigned the wrong textbook pages. The pages I assigned where about small genetic changes and the resulting genetic disorders that occur. However, the students could not formulate a good hypothesis based on this information. Students have been taught that a hypothesis is a testable prediction or a possible answer to a research question. The KQHL guides students to formulate hypotheses based on the research questions that they create during the process. In order to correct this I made an announcement that the pages for their KQHL would be pages 341. 349-353. The pages that I used would be most appropriate for the third week of the unit.

Karyotyping Laboratory activity

Students had a very hard time with making out the nuances of the individual chromsomes, the fact that there were TWO DUPLICATED chromsomoes per number and that there should be a system developed for individual groups to facilitate the completion of the karyotypes. For the students that I helped, I told them that I determine the different chromsomes based on size and patten, For example, chromosomes 4 and 5 look alike, but the kinetochore of 4 is light compared to the kinetochore of 5. The ban design is also unique between the two. Since 4, 5 and 6 chromosomes ar similar in size this skill in differentiation should be emphasized and demonstrated.

Students also needed heuristics made for the laboratory work, some quick “cheat sheet” to go to when they were confused. There is a starting process and a concluding process. In the middle of completing the laboratory activity I made a check off sheet that was associated with the laboratory rubric. This seemed to make it easier for students to focus on what exactly should be done and aided in the decision making processes for students. What I learned is that teachers are to be able to provide cheat sheets, heuristics or check-offs when students are doing a complex, multi-set learning activity. The beginning cheat sheet included the following steps:

1. Pick your teams in which you will work together (at first this was pairs of students; later because of time I decided to allow students to work in groups).
2. Check each others “K”.
    a. This is a part of the experimentation process. Students are to peer review each other’s work. This is meant to lead to discussion about the content but it usually leads to discussion about the procedures. Students are wired to think about procedures and not about how they have viewed and expressed their understanding. Still working on how to do that.
3. Partner 1 completes “A” and “C” karyotypes; partner 2 completes “Normal”, “B” and “D” karyotypes.

    a. This was changed after we got started to groups of students. It would have taken a long time if I was to keep them in pairs. Plus the pairing didn't seem to increase the understanding of the process and thinking behind the laboratory activity. Time was a factor on how deep the understanding of this portion of the unit was more of a factor. Giving time for students to tune into learning was a must.
4. Construct your research questions (5) in total. Remember the should be testable questions based on the text-study and the laboratory protocol.
    a. The questions should pertain to how one can determine the sex of an individual
    b. The chromosomal disorder
    c. And how you can tell whether specifically someone has down syndrome.
        i. This last question is connected to the case study that was used as the engagement activity at the beginning of the learning process.

If I were to do this again, and for future learning processes involving laboratory activities. A check-off seems more appropriate than a list of procedures. The corrections look something like this:

- ✓ Groups identified
- ✓ "K" complete
- ✓ "Q" complete
- ✓ Assigned Karyotypes

In this way, it's more of a quick reference than something specific to do. Because I didn't do this I had to make the following closing check off list

- ✓ "K" is complete –use text study p. 341, and 349-351 and interpreted the information in light of the karyotyping lab. Read over intro to the lab. (10 points)
- ✓ "Q" –5 questions that are testable; have teacher check it off (10 points)
- ✓ "H" –one (1) of the questions form "Q" converted into an "if..then" statement (10 points)
- ✓ Data—at least 1 full karyotype for "developing grade" (2 or more for satisfactory)
    - This is a direct connection to the laboratory rubric. Used for clarification. (10 points)
- ✓ Data-analysis" All 5 karyotypes have tables filled out (15 points)
    - Heading _____
    - Number of chromosomes: _____
    - What is the sex? _____
    - Normal or mutated (circle one)
    - If mutated, name the disorder below
- ✓ Question "L" and back of the laboratory (10 points)

The closing activity in the future will just include the section on data. Plus, it might be best to call it the data collection portion of the experimentation process. The closing would be the argumentation and conclusion section. Which would have it's own check off process.

Argumentation Process:

- ✓ Hypothesis is restated: students need their hypotheses reviewed before they turn in the final laboratory report
- ✓ Argument contains the following information
  - The karyotype with down syndrome
  - How you can determine the sex of each person's karyotype
  - Whether you support or reject your hypothesis and why
- ✓ Conclusion statement
  - Using the textbook provide evidence to explain why your statement in the argument make sense.
  - How karyotyping informs or misinforms the public and would you have karyotyping done to your unborn child
  - Can doctors karyotype your unborn child without permission?

The What We Learning Process:

This is a process that I have developed with students so that students are now in control of the SWBAT. The process is as follows. Students come in and complete their warm up activity given the allotted five or ten minutes. After the time I lead the discussion of the topic and students are free to add to the discussion, ask clarifying questions or give explanations. Once this is done, a designated students then stamps the day's entry, and other designated student writes a summary on the poster paper near the front of the room. The "poster" student then turns around, gives his or her classmates tine to read the poster and ask them "Is this alright?" The class gives a thumbs up if it is or a flat hand to indicate any changes to be made to the class summary. At the end of the day the poster is erased.

5.

Name of Lesson: Heredity 3 Probability and Statistics
Grade Level: 10
Prepared by: Antoinette Linton

Section 3: Lesson Summary
Topic

NGSS Performance Expectation:
HS-LS3-3 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population

NGSS Performance Expectation (Unwrap)

Blooms	DOK	Skills (Verb)	Concepts (Noun)
Application 3* Students have to carry out or use a procedure in producing Punnett Squares and Pedigree charts. Students determine sex-linked and autosomal inheritance patterns and can support this with textual evidence. *model explanation &	Explain the steps 2* Students will use Punnett squares and pedigree charts to solve genetic problems. They will select which one to use, and retrieve information from the square and chart and then translate the information into testable information	Students will ask questions, construct Punnett squares, calculate probability of genetic outcomes	Traits are inherited in patterns. Students will know homozygous dominance, recessive, and heterozygous outcomes. Predict sex-linked traits. They will know who received certain alleles to express normal, mutated, carrier, diseased, etc. (Next Lesson)

California State Standards

California State Standard (Unwrap)

Bloom	DOK	Skills (Verb)	Concepts (Noun)

Priority Vocabulary:

Homozygous Dominant	Tay Sachs
Homozygous Recessive	Sickle Cell
Heterozygous	Down Syndrome
Sex-linked trait	Musc

X chromosome
Y chromosome
Allele
Punnett Square
Pedigree Chart
Carrier
Mutated
Normal
Genotype
Phenotype

Identify the most applicable Crosscutting Concept
The cross cutting concepts is Scale, proportion, and quantity. Students will use Punnett squares to predict the outcomes of individuals mating pairs. Then students will look at inheritance patterns of families as genes are passed from one generation to the next. Finally, students are to use the hardy-Weinberg equilibrium equation to examine scientific data and predict the effect of a change in one variable on another a population in.

Objective of the Lesson or Unit:
Students will discuss how family traits can be predicted when they look at their own families, their family history as well as population trends in the local community. Students will have to interpret and translate the activities presented in this learning experience to answer question about local and familiar trends in heart disease, hypertension, diabetes and other common disorders found in our community.

Culminating Assessment (How will you know students have met the Performance Expectation?)Describe the assessment and attach a copy.

The culminating task will have two parts:
18. Public service announcement explaining how we can prevent expression of genetic disorders by understanding the environmental factors that are under our control.

What has been taught in my class to prepare students for this topic?

Description of the Lesson/Unit (Use the following Table)

5E	Short description of activity	Purpose/Intention for the activity or Key Learning •
Engage	Opening up the learning experience with the scenario	Gives students an opportunity to plan, think about how they will manage the information from the learning

		experience as they receive the materials. The scenario will begin the *focus inquiry* into the learning experience. Students will receive the materials for the learning.
Explore	Case study activity: *In sickness and in health: a trip to the genetic counselor*	Students will use Punnett squares and information from the case to determine genetic outcomes of diseases that are inherited through various modalities.
Explain	.Case study analysis: Group work	Students will participate in the case study analysis activity where they
Elaborate		
Evaluate		

Section Description:

Better Essential Question (3/26/2014): What responsibility do we have as health care buyers, grocery store consumers, and community members to know the relevant information to determine if we are being exploited or if we are being taken care of by private and government institutions?

Section Details: Tying back to the Henrietta Lacks Scenario. Students are still connecting back to the Henrietta Lack's article that started the unit. They are consumers of the genetically modified food, they are future parents who will contend with genetic testing of their unborn children, and they are ethnic minorities who have genetic disposition for diabetes and hypertension. Students will perform tasks and experiments to understand how genetic information can be predicted using Punnett squares and pedigrees. As community members, consumers, potential parents and health insurance consumers they will need to identify relevant pieces of information and understand the personal and community implications of heredity.

Scenario Extension: You are informed community members. You understand how geneticist determines information about human heredity by observing what normal cells do and what causes cells to behave abnormally. You will need to use Punnett Squares and Pedigrees to show the inheritance patterns of certain diseases and disorders that frequently occur in our communities. You will also need to determine what life style changes that we

Task 1: You will research key genetic diseases (hemophilia A and myotonic dystrophy) and how they are inherited and create a family pedigree based on this information. You will determine what is sex-linked and what isn't.

Task 2: You will determine the probabilities of the genetic outcomes of our model community (classroom) when the potential offspring from our families marry and mate to produce offspring.

Task 3: Students will design a pubic service campaign about awareness of a particular genetic topic of their choosing:

- Genetic testing and the way we need to use this information
- Causes of cancer and detecting them in our community
- Genetically modified food in our stores and the choices we have in our community
- Genetic origins of hypertension and diabetes and the life style changes they may need to happen
- Another topic approved by the teacher
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Section 2: Laboratory/ First-hand Approximation of Practice Lesson (From Explore, Elaborate, or Evaluate phase of the 5E Learning Cycle)

Assessment: How will I know students met the objective? Rubric:
Description of lesson:
Time required for the lesson:
Materials/ Preparation needed:

Description of Student Task (each step)	Time Needed for Students to complete each Task	Teacher Notes (Include strategies/questions to check for understanding)	Accommodation/Modification for Student Access and Extension (i.e. strategies for EL and extensions for GATE)

Lesson Plan Template

Section 3: Science Literacy (From Explain, Elaborate, or Evaluate phase of the 5E Learning Cycle)

Content Objective: Language Objective:
Assessment: How will I know students met the objective?   Rubric:
Description of lesson:
Time required for the lesson:
Materials/ Preparation needed:

Description of Student Task (each step)	Time Needed for Students	Teacher Notes (Include strategies/questions to check for understanding)	Accommodation/Modification for Student Access and Extension (i.e. strategies for EL and extensions for GATE)

	to complete each Task		

Section 4: Student Pages

Please provide a printer/copier friendly student pages for Section 2 and Section 3.

Section 5:

I would like to note here that the genetic diseases in the case of *In Sickness and in Health: A Trip to the Genetic Counselor* is not culturally relevant or specific. If I had time I would rewrite this case to include genetic issuses specific to the population of students that I have. Health concerns like diabetes, sickle cell, hypertension and fibroids are real health concerns for our students and their parents. In this way we can begin to discuss preventative ways of living our lives around these health issues and being proactive about health care, health insurance, and taking care of loved ones.

The cases presented are linked to the concepts of autosomal dominant, autosomal recessive, sex-linked, and population genetics. As a teacher I would have to research what common disorders found in the community I serve connect to each one of these concepts, have the students tell me their experienes with these health issues and then map out a way for them to express their concerns, develop proactive mechanisms for future challenges and then interact with the community in a significant way.

Name of Lesson: Natural Selection and Evolution
Grade Level: 10
Prepared by: Antoinette Linton

Section 3: Lesson Summary
Topic

NGSS Performance Expectation:
HS-LS4-1 Students are to communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

NGSS Performance Expectation (Unwrap)

Blooms	DOK	Skills (Verb)	Concepts (Noun)
Application 3* Students are to recognize and be able to communicate different types of evidence to support the common ancestry of life on the planet. &	Explain the steps 2* Students will use case study evidence to show the vital role that fossils play in understanding evolutionary history and to explore the different theories for the origin of flight and the debate over a bird-dinosaur	Students will ask questions, and observe how selective forces can change allele frequencies in a population and cause evolution to occur.	Environmental factors affect expression of traits and affect the probability of occurrences of traits in a population. Evolution connection

	connection. Inquire about the five mechanisms of evolution. They will select which one to use, and retrieve information from the square and chart and then translate the information into testable information		

California State Standards

California State Standard (Unwrap)

Bloom	DOK	Skills (Verb)	Concepts (Noun)

Priority Vocabulary:
Evolution Theory Fossil Artificial Selection Struggle for existence Fitness Adaptation Survival of the Fittest natural selection Vestigial organ Biogeography

Identify the most applicable Crosscutting Concept
Students will be introduced to the different patterns that Darwin was able to observed at the macro scale for evolution. Patterns in animal demography as a result of biogeography, fossil patterns of animal of from similar lines, and the example given was horse evolution, homologous structures, vestigial structures, and DNA evidence.

Objective of the Lesson or Unit:
To understand the evidence of evolution and have discussions concerning this evidence.

Culminating Assessment (How will you know students have met the Performance Expectation?)Describe the assessment and attach a copy.

The culminating task will have two parts:
19. Students will be able to *frame* the information from the case study to make tenets of understanding of evolution in order to judge the credibility of scientific and social claims made about evolution in the media, in text, and in other social ways of acquiring information.
20. Students will complete the movie guide for Jurassic park, they will refine their concept map as they learn more information about evolution.

What has been taught in my class to prepare students for this topic?
Students understand how to use and refine a concept map. Students know how to work together to discuss the content of a case study.

Description of the Lesson/Unit (Use the following Table)

Lesson Plan Template

5E	Short description of activity	Purpose/Intention for the activity or Key Learning •
Engage	Opening up the learning experience with a case study: *Seven Skeletons and a Feather: The Mysteries of Archaeopteryx* National center for case study teaching in science	Students will be given a case study analysis activity. This process includes a *focus inquiry* into the components of the case. First students will read the case, answer the questions and determine what they already know. Then the students in the group rotate to discuss and analyze the case study and produce a document for the group.
Explore	A look at fossils	This is a first hand approximation of practice. Students will describe the types of fossils and other evidence used understand evolution.
Explain	.Framing process	Students use text information, concept map, case study, and experience to develop a framework for understanding evidence of evolution. This framework can be used to evaluate the information about evolution that students are exposed to in the media, community organizations, readings and every day conversations.
Elaborate	http://www.bozemanscience.com/004-evidence-for-evolution	This video lists major evidence for the existence of evolution. Starting with Charles Darwin and including biogeography, fossils, and homologies.
Evaluate	Assessment	Students will be able to use their framework to evaluate the evidence presented in media and text, as well as complete an assessment on Jurassic Park the movie.

Section Description:

Students and I begin the unit with another case study that engages students in a problem-based learning activity that uses *Archaeopteryx,* the most famous fossil in the world. This case is intended to show the role of fossils in understanding evolutionary history and to explore the

different theories for the origin of flight and the debate over a bird-dinosaur connection. But better yet, this learning experience in its totality is to equip students with the understanding that what they are told about evolution and what is researched could be two different things and that they should develop frameworks or conceptual maps to judge the information that they are bombarded with. The case study is used to introduce the unit in a fundamental way, aligned with the research theme of the course. The case is supported with the Bozeman video of evidence of evolution, classroom samples of fossils, independent study with workbook pages, and an interpretative activity using Jurassic park.

Section Details: The next 100 years will be the century of biology. Students will need to understand evolution in order to have a say and be prosperous in the century of biology. Students will take a historical view of the history of teaching science. We want to help students be qualified for jobs and be truly informed. Students need to develop a well though-out conceptual map or other document explaining evolution and how it prepares them for the 21st century.

Scenario Extension: You are an informed community member who has heard conflicting information about the origins of human beings on the planet. In school (like in middle school) you heard that human beings are somehow related to monkeys. In church you have heard the story of Adam and Eve. How can both of these stories exist? Who is right? How can we determine who to listen to and who to ignore?

Task 1: Students will develop a framework of understanding concerning evidence of evolution. The framework will be a summary of the types of evidence and examples that can be found in the laboratory and in the world.

Task 2: Students will develop and refine a concept map used to evaluate evidence of evolution in case studies, Jurassic Park, and other class discussions.

Task 3: Jurassic Park the movie activity

Section 2: Laboratory/ First-hand Approximation of Practice Lesson (From Explore, Elaborate, or Evaluate phase of the 5E Learning Cycle)

Assessment: How will I know students met the objective? Students will be able to add information to their famework that relates to how fossils are collected, analyzed and used to support an understanding of evolution. Rubric:
Description of lesson: Students will be allowed to observe fossils found in the classroom. In addition, they will be able to look at the similarities and difference between different animal forms of the same phylum. Students will have to do the following:

Lesson Plan Template

Describe the physical characteristics Measure the length of the organisms or their remains Compare and contrast the anatomy of the fossils to other similar animals Explain why the animals and their remains were grouped at the same taxonomy level
Time required for the lesson: 1 class period
Materials/ Preparation needed: Fossils Preserved specimens Handout for taking observational data (qualitative data) AP Biology books and general biology books with designated pages

Description of Student Task (each step)	Time Needed for Students to complete each Task	Teacher Notes (Include strategies/questions to check for understanding)	Accommodation/Modification for Student Access and Extension (i.e. strategies for EL and extensions for GATE)
Students use the concept map to begin their framework	10 minutes	Students will need the framework handout to start the activity. Facilitative questions include: 1) *What is the scientific evidence for evolution?* 2) *What are the topic and community reasons why we need to know the mechanisms of evolution* 3) *What are the ethical reasons why we need to know the mechanisms of*	EL students will be able use whatever language level in English to communicate their understanding of Evolution and what is valuable to them. GATE students who may have already developed sophisticated knowledge about evolution will be able to share their knowledge with other classmates.

		evolution?	
Analysis of fossils	1 class periods	Students will handle and evaluate fossil evidence of evolution.	Students will be able to use the text book to Compare fossils, to analyze preserve specimens, and to make claims about organism relationships.
Bozeman Science Evidence of evolution	15 minutes	Students will add information from the video to their concept maps.	Students will ask for assistance and talk about the components of the video that are interesting. These concept maps will be used to help students evaluate the evidence of evolution found in the Jurassic Park movie
Jurassic Park movie	2 class periods	Students will watch and discuss the evidence found in the movie. They will critique the evidence and add to or refine their frameworks.	Most students have seen the movie and will ask questions about what in the movie is real and what isn't. This is an opportunity to talk about the evidence of evolution as discussions come about.

Section 3: Science Literacy (From Explain, Elaborate, or Evaluate phase of the 5E Learning Cycle)

Content Objective: **Evidence of evolution** Language Objective: Construct viable arguments (building the framework) and critique reasoning of others (argument between creationism and evolution from the scenario).
Assessment: How will I know students met the objective? Students will be able to use the tenets of their framework to construct a reasonable argument as to why creationism does not have its place in a science class. Students will use information from the case study, textbook, Bozeman video, and Jurassic Park the movie to extrapolate information to construct arguments and critique arguments for creationist teaching in public classrooms.

Lesson Plan Template

Rubric: Components of the argument rubric will be used to self-assess the products students use.
Description of lesson: Students will complete the following activities and then review the scenario and construct a response to individuals who might ask this question "Why can't we teach creationism in science class?" 1) Copy down starter concept map 2) Make refinements to the concept map as students complete workbook pages, watch the Bozeman video and complete the reading of the case study.
Time required for the lesson: 1 class period
Materials/ Preparation needed: Notes, concept map, case study information. The scenario

Description of Student Task (each step)	Time Needed for Students to complete each Task	Teacher Notes (Include strategies/questions to check for understanding)	Accommodation/Modification for Student Access and Extension (i.e. strategies for EL and extensions for GATE)
Case Study Analysis	1 class periods	Students will read the case study and add details to their framework about fossil evidence (#1 of the framework). Students are also required to do the following: *1) Create document for the group that includes the name of all members, period, and date.* *2) For each section of the case write the common ideas and knowledge that group members know.*	Students are given explicit directions on how to complete the is activity.

		3) *For each section, tell why the information is important for our lives.*	
Argument and Critique	1 class period	Students will use a graphic organizer to construct an argument against teaching creationism in science classrooms	Students must read, write, view and visually represent as they develop their arguments. They speak and listen as they present their ideas and engage in reasoned argumentation with others to refine their ideas and reach shared conclusions.

Section 4: Student Pages

Please provide a printer/copier friendly student pages for Section 2 and Section 3.

Section 5:

Case Study: Seven Skeletons and a Feather: The mysteries of Archaeopteryx

The case allows students to test out their fameworks made from the concept map and to refine the framework to fit in the important facts of the fossil evidence for Archaeopteryx. Important facts that students will be made to attend to include Huxley's critical paper ideas where he points out two statements about the observational data from the fossil. The head of the original fossil was not found and thus the scientists could not make claims about whether it had teeth or not. Secondly, comparative anatomy between living birds, and the fossil revealed similarities between the small dinosaur *Composgnathus*.

The second question on page 2, "Whereas evolutionists such as Huxley were delighted with the discovery of *Archaeopteryx*, Creationsists (even today) argue that *Archaeotpteryx* is no big deal. What is their problem with viewing these specimens as proof that evolution did occur? Why don't they accept the evidence that *Archaeotpteryx* is a transitional form? There are some problems with the second part of question 2, scientists support or reject hypotheses we do not prove them. This will inform the scientific evidence of evolution and garner discussion amongst the whole class. It is important that students understand and attend to some of these issues in the case.

It is also important to note that many students will want to do other work, sleep or other activities during the movie because they either own it, or will watch it online when they get home. Some will do this, but most will not. Stop and start the movie in particular places to extend the concept map, add to the growing framework, or answer questions on the movie guide. Students need to understand that this is a guided experience and that the activity is just right outside of their zone of proximal development, ***not just with the content but with the process of organizing and operationalizing the content.***

Jurassic Park The Movie

Students consistently ask the question "can this really happen" when they ask about the movie Jurassic Park. The response I give is that no…we can't create the dinosaurs that are seen in the movie because the cells/genetic material needed to clone dinosaurs has long sensed been replaced by minerals through the fossilization process. Students are generally interested in the topic of fossils and other types of evidence but do not make the connection between fossils and evolution. It seems that the two have been separated cognitively somehow.

What is generally important is to help students attend to the details of the movie as it relates to the evidence of evolution. This should be systematized. Therefore, for this activity we watched the film and paid close attention to it (stopping and starting). Students were given opportunities to pay close attention to memorable scenes, quotes and other visuals that placed evolution in

context. This method of watching and then talking allowed the students to think thoroughly about the subject matter while writing as much descriptive information about the film as possible.