SAN LEANDRO UNIFIED SCHOOL DISTRICT
COURSE PROPOSAL

SECTION A. COVER PAGE

1. **Course Title:** Genetics & Biotechnology	7. **Action** X New Course Course Revision ▢ Title Change Only
2. Date Submitted: 12/12/16	8. **Grade Level** X10 X11 X12
3. Transcript Title/Abbreviation(s)	**9. Prerequisites** (Please list.) ❑ **Biology Required(C recommended B or better highly recommended)** ❑ **Chemistry Recommended** ❑ **Physiology Recommended**
4. Transcript Course Code/Course Number :	**10. Seeking Program Distinction?** ❑ YES (Check one below.) ❑ NO ❑ ▢ **CP** ▢Honors ▢ AP ❑ Other
5. Subject Area: Science (Biomedical Health Pathway)	11. **Is this a CTE course?** ▢ **NO** Course **If YES, complete Section C**
6. **Department**: Science(Biomedical Health Pathway)	12. **Previously approved by UC?** ***YES***
13. UC ELIGIBILITY **Already eligible? On UC Doorways, will submit for SLHS** **a** ▢ **b**▢ **c**▢ **d**▢ **e**▢ **f**▢ **g** **Proposing eligibility?** **a** ▢ **b**▢ **c**▢ **d**▢ **e**▢ **f**▢ **g** Please mark one for approved eligibility or proposed eligibility.	14. **Unit Value/Course Credit/Length of Course** ❑ 0.5 (semester or half-year) ❑ **1.0 (one year equivalent)** ❑ 2.0 (two-year equivalent) ❑ Other
15. School Contact: Name: Keziah Moss & Gaia Pine/Yesim Alamzai Phone: Email: kmoss@slusd.us , gpine@slusd.us /yalamzai@slusd.us Position:Assistant Principal , Instructional Coach /teacher	
16. Signatures: 	**DISTRICT OFFICE USE ONLY**

Department Chair: Sarah Kayler Principal: Dr. Reggie Richardson	**Date approved by Board Curriculum Committee** **1/31/17** **Date approved by Board**

SECTION B. COURSE CONTENT

17. Course Description and Objectives:

Although the principle concepts of genetics have been known for only 100 years, genetic selection has been conducted for many centuries on domesticated animals (i.e. dogs) and
food crops (i.e. corn). The field of genetic research, although still in its infancy, represents a fundamental aspect of human biology. While recent advances in genetic research have provided a greater ability to diagnosis and treat various human abnormalities, such as cancer, they have also produced many ethical and political considerations, which are still hotly debated and remain unresolved. This class will provide students with an understanding of the principles and concepts of genetics. Students will learn to integrate the most important concepts in classical and molecular genetics into an overall picture of what a gene is, how it functions, how it may be altered and how it is inherited. This course will study the molecular basis of gene function and mutation, Mendelian genetics, transmission systems, regulation of cellular processes, developmental genetics, cytoplasmic inheritance, population genetics and multifactorial inheritance. Students will learn about recent advances in biotechnology that have genetic implications, including the Human Genome Project and advances in genetic engineering technology. *Specific objectives of this course are to provide an understanding and discuss ramifications of: 1)Inherence, 2) Gene Structure, 3) Gene Function, 4) Gene Mutation, and 5) Evolutionary and Ecological 6)Ethical issues related to genetic research and its applications.*

18. Course Goals and/or Major Student Outcomes

Level of cognitive understanding	**Description**	**Representative verbs**
Factual knowledge	Remember and recall factual information	Define, list, state, label, name
Comprehension	Demonstrate understanding of ideas and concepts	Describe, explain, summarise, interpret, illustrate
Application	Apply comprehension to unfamiliar situations	Apply, demonstrate, use, compute, solve, predict, construct, modify
Analysis	Break down concepts into parts	
Synthesis		

Evaluation	Transform and combine ideas to create something new Think critically about and defend a position	Compare, contrast, categorise, distinguish, identify, infer Develop, create, propose, formulate, design, invent Judge, appraise, recommend, justify, defend, criticise, evaluate

Objectives:
Students will:
- design and/or evaluate a scientific investigation using evidence of scientific thinking and/or problem solving.
- interpret and analyze data to make predictions and/or defend conclusions.
- evaluate the merits of scientific explanations produced by others.
- assess the reliability of sources of information according to scientific standards.
- demonstrate safe practices in a science laboratory.
- evaluate and construct models that are utilized in the practice of science.
- make applications using knowledge acquired through curriculum

Course supports careers in:
- Advanced Biosciences
- Clinical Laboratory Scientist Preparatory Programs
- Health Profession Programs

19. Course Objectives (standards)

Common Core State Standards Connections:

ELA/Literacy -

RST.11-12.1	**Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS1-1)**
RST.11-12.9	**Synthesize information from a range of sources into a coherent understanding of a process, phenomenon, or concept resolving conflicting information when possible.**

WHST.9-12.2	**Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-1)**
WHST.9-12.7	**Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)**
WHST.11-12.8	**Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. *(HS-LS1-3)***
WHST.9-12.9	**Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-1)**
SL.11-12.5	**Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-2)***

NGSS:

HS-LS1-1 From Molecules to Organisms: Structures and Processes

Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

HS-LS1-4 From Molecules to Organisms: Structures and Processes

Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

HS-LS1-6 From Molecules to Organisms: Structures and Processes

Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

HS-LS2-8 Ecosystems: Interactions, Energy, and Dynamics

Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

HS-LS3-1 Heredity: Inheritance and Variation of Traits

Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

HS-LS3-2 Heredity: Inheritance and Variation of Traits

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.

HS-LS3-3 Heredity: Inheritance and Variation of Traits

Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

HS-LS4-1 Biological Evolution: Unity and Diversity

Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

HS-LS4-2 Biological Evolution: Unity and Diversity

Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

20. Course Assignments:

Genetics Lab Manual **(A hard copy will be made based on the curriculum labs indicated below)**

Lab Reports:

The complete lab report will contain the following sections: Abstract, Introduction, Materials and Methods, Results including Figures and Tables with captions, Discussion, and References. Reports are to be submitted electronically to Google Classroom.

Lab Assignments:

Each of the genetics labs has an assignment that must be completed by the student. These will be collected at the beginning of the next lab period. Assignments are to be submitted electronically to Google Classroom.

Problem Sets:

Problem sets will be assigned for each chapter covered during lecture periods. These problems will not be collected and graded, but students are strongly advised to work through the problems. Material from the problem sets may be included on examinations.

Course Outline (40 weeks)

1. **Introduction**
   1.1 Fields of Genetics
   1.2 Methods of Studying Genetics
   1.3 Cell as a System
2. **Molecular Genetics**
   2.1 DNA as the Genetic Material(From DNA to Protein)
   2.2 DNA tools and techniques
   2.3 Control of Gene Expression(Prokaryotic vs Eukaryotic Systems)
   2.4 Microbial Models: Genetics of Bacteria & Viruses
   2.5 Applications of DNA Technology

First Exam

3. **Chromosomal Basis of Heredity**
   3. 1 Chromosomal Structure and Behavior During the Cell and Reproductive Cycles.
   3.2 Genetic Implications of Mitosis & Meiosis
   3.3 Chromosomal Basis of Sex Determination
4. **Mendelian Genetics**
   4.1 Laws of Mendel
   4.2 Probability, Genetic Ratios, and Test of Significance
5. **Modification of Mendelian Genetics**
   5.1 Dominance Relations
   5.2 Multiple Alleles
   5.3 Sex linked Inheritance
   5.4 Gene Interactions and Lethality

Second Exam

   5.5 Polygenic Inheritance
   5.6 Extrachromosomal Inheritance

6. **Chromosomal Aberrations**
   6.1 Change in Chromosomal Structure
   6.2 Change in Chromosomal Number
7. **Linkage and Chromosome Mapping**
   7.1 Arrangement of Linked Genes
   7.2 Linkage Maps

Third Exam

8. **Quantitative Genetics**
   8.1 Separation of Variance Components
   8.2 Broad Sense vs Narrow-sense Heritability

9.1 Population Genetics and Evolution

   9.1 Hardy-Weinberg Law of Equilibrium
   9.2 Alterations of Genetic Equilibrium
   9.3 Evolutionary Genetics
   9.4 Ecological Genetics

Lab Schedule: Labs will be conducted through in class settings and/or virtual labs.

Virtual labs

Lab#1:

A) Safety; Notebooks; Scientific Method; ***Micropipetting.***

B) Mitosis and Meiosis Microscope; Chromosome simulation: Allele segregation and sorting. Design of experiments; Chi Square tests.

Assignment: Questions

Lab#2:
DNA Restriction Digest analysis. Genotypic and. Phenotypic analysis; Prism.
Assignment: Questions and Standard Curve graph. Results Section
Lab#3:
A) Rapid Colony Transformation of E. Coli or Yeast. ***Grow Cultures***
B) Flower Breeder
Assignment: Questions, Transformation graphs and Flower Breeder.
Lab#4:
A) Analyze Plates and determine transformation efficiency. Discuss
Transformation efficiency. Discuss: Standard curves
B) Gene cloning and sequencing experiment: DNA Extraction and PCR
Assignment: Questions.
Lab#5:
A) Gene cloning and sequencing experiment: Restriction Digest and Nested PCR
B) Isolation/Quantification of Genomic DNA
Assignment: Questions
Lab#6:
A) Gene cloning and sequencing experiment: ***Purify PCR products***
B) Gene cloning and sequencing experiment: Ligation and Transformation
Assignment: Questions.
Lab#7:
A) Gene cloning and sequencing experiment: Miniprep and ***Restriction Digest***
B) Amplification and Sequencing of Mitochondrial DNA
Assignment: Questions
Lab#8:
Gene cloning and sequencing experiment: Sequencing Reaction
A) Population Genetics: Allelic and Genotypic Ratios. Hardy-Weinberg Law and assumptions.
B) Mitochondrial PCR reaction: ***Gels***
Assignment: Questions.
Lab#9:
A) DNA Fingerprinting analysis. Comparison of suspect DNA with a crime scene sample. Restriction Digest based
B) Detection of Alu Insertion by PCR
Assignment: Short report with standard curve graph
Lab#10
A) DNA Fingerprinting analysis: Run Gel
B) Plasmid Mapping
C) Detection of Alu Insertion : Gel
D) DNA Fingerprinting analysis: Comparison of suspect DNA with a crime scene sample. PCR
Assignment: Questions and Plasmid Maps.

Lab#11:
A) Gene cloning and sequencing experiment: Bioinformatics (Sequence Analysis)
B) Mitochondrial Sequence Analysis
C) DNA Fingerprinting analysis: Comparison of suspect DNA with a crime scene sample. Gel
D) Review for Lab Practical

Assignment: Questions. Gene Cloning

LAB PRACTICAL: During finals week.

Building Scientific Vocabulary:
400 Scientific Root Words, Prefixes and Suffixes
To enrich students understanding of genetic terminology over 400 scientific root would will be learned and used when reading scientific text. There will be weekly quiz on twenty scientific root words, prefixes and suffixes.
(http://www.biologyjunction.com/prefixes%20and%20suffixes.pdf)

Field Trips and Speakers (1 week +, divided throughout the course)
Opportunities to meet real professionals and tour facilities is an important part of this course. Students will prepare for the speakers and field trips by completing the KWL chart below. They will then write a two paragraph reflection about what they learned and how the career presentation impacted their personal goals.
https://www.eduplace.com/graphicorganizer/pdf/kwl.pdf

Scheduled presentation with community industry partners are listed below
Fieldtrips -

Biotech Companies
Laney college - Biotechnology: tour of the CTE accreditation program
Berkeley City College
CSUEastBay

Speakers -

Scheduled throughout course

Pre-assessment (1 week):

- Lab skills(conduct)
- Use of microscopes
- Lab equipment recognition
- Pre-assessment test on Genetics based on Biology knowledge.
- Measurement

21. Instructional Materials:
Supplementary materials
Genetics textbook

GENEed

computer access; school library, industry partners for field trips, guest speakers, professional interviews; field trips to local community colleges and universities/colleges
https://www.eduplace.com/graphicorganizer/pdf/kwl.pdf
(http://www.biologyjunction.com/prefixes%20and%20suffixes.pdf)
credible current event resources

22. Key Assignments

Students will participate in labs weekly and complete lab reports and answer problem sets. Students will complete two research papers. Work based learning experiences will be implemented throughout course. Students will be required to keep a lab notebook.

23. Instructional Methods and/or Strategies

The purpose of this course is to engage students in the discovery and learning processes of genetics . This approach requires active student engagement and participation with the teacher acting as facilitator. The learning will focus on real world and relevant topics. Whole class activities will involve sharing ideas, knowledge, careful consideration and challenge of others' ideas, and supporting claims with evidence and reasoning. Individual study will be self-directed with support from teacher. Teacher will meet with individual students frequently to monitor progress and guide the process of self discovery. While the majority of the learning will be student centered, teacher planning and organization remain valuable requirements. Strategies will include:

- Project-Based Learning
- Seminar Style, Student Lead Discussions based on Text Dependent Questioning
- Peer Collaboration
- Analysis and Close Readings

24. Assessment Methods and/or Tools

Students will be assessed using multiple measures: 4 major tests, lab practical, lab reports, class participation, Lab Notebook , Lab NB Rubric, presentation (in person or Google Slides) **rubrics,** quizzes and research papers.

25. Grading Policy

Grading will follow the San Leandro Unified School District's policy.

26. Supplies

Recommended/Suggestions

SECTION C

27. Context for Course

The California Career Pathways Trust grant supports schools to develop career relevant curriculum and provide articulated pathways to postsecondary education. San Leandro Unified School District is a recipient of the Career Pathway Trust Grant and is developing a Biomedical Health Pathway. This elective course was created to fill an area that does not exist here at San Leandro High School. This course will provide information, education and skills to explore and understand Biotechnology. This course will support students' learning in genetics and the Biomedical Health pathway.