Pasadena Unified School District
BIOLOGY: 9 – 12TH
HS – LS3 Heredity: Inheritance and Variation of Traits

Stage 1: Desired Outcomes

Priority Standards

What Priority Next Generation Science Standards frame the learning objectives of this unit?

- **HS-LS3-1:** 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:** 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:** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Supporting Standards

What supporting Next Generation Science Standards and Common Core Standards are important to the objectives of this unit?

Next Generation Science Standards

- **LS1A: Structure and Function**
  - All Cells contain genetic information in the form of DNA molecules.
  - Genes are regions in the DNA that contain the instructions that code for the formation of proteins.
- **LS3.A: Inheritance of Traits**
  - Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA.
  - All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.
- **LS3.B: Variation of Traits**
  - In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation.
  - Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation.
  - Environmental factors can also cause mutations in genes, and viable mutations are inherited.
  - Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus, the variation and distribution of traits observed depends on both genetic and environmental factors.

Common Core Standards

ELA/Literacy –

- **RST.11-12.1:** Cite Specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author

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makes and to any gaps or inconsistencies in the account.

- **RST.11-12.9:** Synthesize information form a range of sources (i.e. texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflict information when possible.
- **WHST.9-12.1:** Write arguments focused on *discipline-specific* content.

Mathematics –

- **MP.2:** Reason abstractly and quantitatively.

21st Century Skills

What 21st Century Skills will students be expected to demonstrate upon completion of this unit?

☒ *Learning & Innovation (4 C's)* ☒ *Information, Media & Technology*

☒ *Life & Career* ☒ *21st Century Themes*

Enduring Understandings *Big ideas at heart of the discipline; specific understandings desired about them.*	**Essential Questions** *What provocative questions will foster inquiry, understanding, and transfer of learning? Will need to come back and revise these questions*
• The role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. • How 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. • The variation and distribution of expressed traits in a population.	• How do cells reproduce? • What are the principles of Mendelian genetics? • What are the inheritance patterns of human genetics? • What is the mechanism for inheritance of traits? • How do errors in DNA replication affect living organisms? • How do environmental factors inflict DNA mutations in living organisms?
Key Knowledge *As a result of this unit, students will know…*	**Key Skills** *As a result of this unit, students will be able to…*
• Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. • The instructions for forming species' characteristics are carried in DNA. • All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. • Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function • All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. • In sexual reproduction, chromosomes can sometimes swap sections	• 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.

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during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. • Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. • Environmental factors can also cause mutations in genes, and viable mutations are inherited. • Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors	

Stage 2: Assessment	
Performance Task: Drosophila Fly Lab	Other Evidence: *(project benchmarks quizzes, unit tests, multiple choice tests, etc)*
In this experiment, students will • Learn basic handling and culture techniques for working with Drosophila. • Apply concepts and principles of Mendelian inheritance patterns to solve genetics problems. • Diagram sex-linked crosses. • Gain experience sorting by gender and observing Drosophila phenotypes and their modes of inheritance. • Students will be keeping and analyzing data resulting from crossing flies and use the data obtained to determine inheritance patterns. (autosomal vs. sex-linked) • Students will apply test-crosses to solve genetics problems.	• Assigned readings and reading assignments • Class notes • Videos/visual aids • Lab notebook (for lab work) • Other related activities and labs o Penny Genetics o Phenotype Activity o Watson-Crick Model DNA Model • Vernier Labs o Genetics of Drosophila Lab • Other related labs o Molecular Biology Labs

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PART A:	S T A G E 3 O V E R V I E W		page 1	
Name of Project:	**Drosophila Fly Lab**		**Duration:**	2 weeks
Subject/Course:	Science: Biology	**Teacher(s): Secondary Biology Teachers**	**Grade Level:**	9 - 12
Other Subject Areas to Be Included:	**Mathematics –** • Reason abstractly and quantitatively. **ELA/Literacy –** • Synthesize information form a range of sources (i.e. texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflict information when possible. • Write arguments focused on *discipline-specific* content.			
Project Idea Summary of the issue, challenge, investigation, scenario, or problem:	• Students will examine the way various inheritance patterns using *Drosophila melogaster* as a model. They will also be analyzing genetic outcomes and predicting the patterns of inheritance of specific traits in future generations. **FOR THIS LAB, ALL STUDENTS ARE REQUIRED TO COMPLETE THE EXTENSION SECTION OF THIS PERFORMANCE TASK.**			
Driving Question	• How does the chromosomal basis of inheritance provide an understanding of the patterns of transmission of genes? • How can you explain the inheritance patterns of traits that do not follow simple Mendelian genetics?			
Content Standards to be taught and assessed**:**	What **Key Knowledge** will students master? What will they know? Enduring Understandings? *Key Knowledge* • The instructions for forming species' characteristics are carried in DNA. • All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. • In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. • Environmental factors can also cause mutations in genes, and viable mutations are inherited. • Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus, the variation and distribution of traits observed depends on both genetic and environmental factors.			

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	Enduring Understandings • The role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. • How 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. • The variation and distribution of expressed traits in a population. What Key Skills will students be asked to develop and/or apply? • 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.			
21st Century Skills to be taught and assessed**:** *How will they be taught and assessed?*	Collaboration Students will • Work in small groups to analyze data obtained. • Work together to decide on the best way to process and present their experimental findings.	☒	Creativity/Innovation Students will • Think and work creatively as one cohesive unit. • Use critical thinking and problem solving skills to determine patterns of inheritance and design their own crosses and predict their outcome • Make judgments and decisions as Individuals and part of a group to effectively analyze and evaluate evidence, major alternative points of view, and interpret and draw conclusions. • Design inquiry-based labs.	☒
	Communication (Oral Presentation) Students will • Learn to present their experimental findings in a	☒	Critical Thinking/Problem Solving Students will • Think and work creatively as one cohesive	☒

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	clear and concise manner and explain their significance.		unit. • Use critical thinking and problem solving skills to determine patterns of inheritance and design their own crosses and predict their outcome • Make judgments and decisions as Individuals and part of a group to effectively analyze and evaluate evidence, major alternative points of view, and interpret and draw conclusions. • Design inquiry-based labs.	
	Life & Career: Students will • Learn to be flexible and adapt to various learning situations (i.e. group settings) • Learn to take Initiative and be self-directed learners by ○ Managing goals and time ○ Working independently and in a group setting.	☐	Other:	☐

Major Products & Performances	Group:	• Students will learn to present their experimental finding in a clear and concise manner and explain their significance. They will also learn to collaborate in small group setting and learn to be flexible and adapt to various learning situations. Students will also learn to plan, implement and evaluate experimental findings in a group as well as individually.	**Presentation Audience** *(entire project)* **Presentation Audience:** Class School

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Major Products & Performances	Group:		☒ Class ☒ School ☒ Community
	Individual:	• Students will learn to keep and maintain a laboratory notebook. They will also learn to properly record experimental findings and present them in written form in their lab notebook.	☒ Experts ☒ Web ☒ Other:

LEARNING PLAN: Does it incorporate Authenticity, Choice, Inquiry & students playing the Active Role?

PBL Guiding Principles:

☒ **Authentic,** compelling scenario that matters to student, field, or community
☒ Considers multiple roles/perspectives
☒ Allows for student **choice**
☒ Point of view/argument that faces opposition
☒ Engaging, high stakes, with a sense of urgency
☒ Transforms or creates content, and opens new questions or cycles

What **Performance Assessment Task(s)** will be generated by this project *that is aligned to standards and key skills*:

☒ Math Analysis (Problem Solving) ☐ English Textual Analysis ☒ English Research/Argumentation ☒ Scientific Research ☒ Scientific Inquiry ☐ History/Social Science Research/Inquiry ☒ Other: presentation and communication	Notes:

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L E A R N I N G P L A N					
Entry Event to launch inquiry, engage students: *Students will be introduced to the concept of heredity and various patterns of inheritance (dominant, recessive, sex-linked, etc), which will serve as a model to help them understand the major goals and objectives of the Performance Assessment Task Lab Activity*		**Benchmark Order**	**Benchmark Category**	**Benchmark Description - what is the assessment?**	**Benchmark Skills – what will this help them to be able to do?** *If a benchmark asks them to report on what they have researched, then they will be able to complete independent research, summarize information, synthesize information, etc*
Assessments *Under each type of assessment there are ideas as to some you might use. These lists are not exhaustive. You may choose to include others not listed.* *The number of benchmarks may be more or less than the number listed. Feel free to document the amount that you will use. If you need more, you may use another sheet.*	**Formative Assessments** (During Project) i.e., *Quizzes/Tests, Journal/Learning Log, Preliminary Plans/Outlines/Prototypes, Rough Drafts, Practice Presentations, Notes, Checklists, Concept Maps*	Benchmark 1:	☒ Know (mastery) ☐ Do (application) ☐ Reflect (metacognition)	Students will be introduced and assessed on the various types of inheritance patterns learned in class. Students will be given problems that directly assess specific patterns of inheritance and other problems where they will have to identify the pattern of inheritance based on F1 and/or F2 progeny data.	This will help students understand the concepts behind heredity. Students will also learn the various patterns and understand why certain traits exhibit specific patterns.
		Benchmark 2:	☒ Know (mastery) ☒ Do (application) ☒ Reflect (metacognition)	Students will be assigned a trait survey the occurrence of their trait among people in their school population or in their family. They will be asked to keep data on the occurrence of their	Students will apply their skills in taking and keeping data to help them complete the Performance Task for the unit.

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Benchmark 2:	☒Know (mastery) ☒Do (application) ☒Reflect (metacognition)	trait and identify (where possible) the pattern of inheritance for that trait.	Students will apply their skills in taking and keeping data to help them complete the Performance Task for the unit.
Benchmark 3:	☒Know (mastery) ☒Do (application) ☒Reflect (metacognition)	Drosophila Fly Lab: Students will use Drosophila to identify patterns of inheritance in a living organism. Students will learn how to follow proper lab protocol when working with living organisms. In addition, students will get to observe traits and figure out the pattern of inheritance in their organism. They will then be asked to possibly cross (mate) their organism and predict the expected outcome in the offspring. They will be keeping individual (group) and class data.	Students will be allowed to look at how the traits that they read about are really inherited. Students will also get a chance to understand why some traits seem to "disappear" in one generation only to "reappear" again in following generations.
Benchmark :	☐Know (mastery) ☐Do (application) ☐Reflect (metacognition)		
Benchmark :	☐Know (mastery) ☐Do (application) ☐Reflect (metacognition)		

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	Summative Assessments (End of Project) i.e.,*Written Product(s) with rubric, Oral Presentation with rubric, Multiple Choice/Short Answer Test, Essay Test, Other Product(s) or Performance(s) with Rubric, Self-Evaluation, Peer Evaluation*	Benchmark :	☐Know (mastery) ☐Do (application) ☐Reflect (metacognition)		
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		Benchmark :	☐Know (mastery) ☐Do (application) ☐Reflect (metacognition)		

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PART B:

Project Launch – Start with a Bang!

Launch Guiding Principles:

- ☒ High interest, provocative, communicates a sense of urgency
- ☒ Provides overview of project without going into too much detail
- ☒ Provides models/examples of culminating products
- ☒ Provides timeline with major benchmarks
- ☒ Motivating - urges students to explore what is possible within the project
- ☒ Presents an exciting challenge that also feels attainable, students can imagine themselves accomplishing the project
- ☒ Addresses the question of "So what…?"

What venue will you use to launch this project (community meeting, multiple classes, within your class, field trip, etc.)?	**Who will be involved in the launch (multiple teachers, just you)?**	**When will you launch this project?**
Launch Agenda: In-class activity	Staff Roles: Teacher – Facilitator Students – Participants	October 8 thru November 9, 2012

Action Steps/Follow Up after the launch:
DATA ANALYSIS – Analyzing Results

- Class discussion on individual and group data

Resources Needed	**On-site people, facilities:**	• Teacher, TA (to help students with set up or other related questions), lab classroom with internet access (wireless) and electric outlets for students to research any related questions they may have.
	Equipment:	• Computers (laptops) with wireless internet access
	Materials:	• Paint brushes, dissecting scopes, glass slides, Fly Nap (to anesthetize flies), Drosophila flies with various mutations and wild type traits.
	Community resources:	• CAPSI/Caltech • Oak Crest Institute of Science • Amgen-Bruce Wallace

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Reflection Methods	**(Individual, Group, and/or Whole Class)**	Journal/Learning Log • Students will be keeping a lab notebook where they will record the progress and results of their lab including any discussion	☒	Focus Group	☐
		Whole-Class Discussion	☒	Fishbowl Discussion	☐
		Survey	☒	Other: Data collection and analysis	☒

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