CCPS Science Unit Plan

Grade	9-12	**Subject**	Biology	**Unit #**	2
Unit Name	Growth and Heredity		**Timeline**	4 weeks	
How to use the Framework	This Framework should be used to implement daily science instruction. The resources and instructional strategies reflected in the Framework will provide a foundation for effective implementation and student mastery of standards. Please see the hyperlinked abbreviation document to ensure understanding all abbreviations used with this framework.				
Unit Overview	**Note: Structure and function is a major theme throughout growth and heredity. Macromolecules (nucleic acids and proteins) and cell organelles responsible for protein synthesis, meiosis, and sexual vs asexual reproduction should also be taught where appropriate. Lipids and carbohydrates will show up in Unit 2, as well as the other important cellular processes such as photosynthesis, respiration and homeostasis.** 1. **Patterns and mechanisms of inheritance** 2. **Mendelian genetics** 3. **Meiosis** 4. **Chromosomes and karyotypes** 5. **Sexual and asexual reproduction** 6. **Molecular inheritance** 7. **DNA replication** 8. **Expression of Traits** 9. **Mutations** 10. **DNA Technology**				
Lesson Plan guidance document and template	Department of Science Guidance Document Lesson Plan Template Week View GADOE Science Updates				

3Dimensional Instruction

GSE	Science and Engineering Practices	Crosscutting Concepts
SB1. Obtain, evaluate, and communicate information to analyze the nature of the relationships between structures and functions in living cells. **b. Develop and use models to explain the role of cellular reproduction (including binary fission, mitosis, and meiosis) in maintaining genetic continuity.**	**Obtain, evaluate, and communicate information** **Engaging in arguments from evidence** **Asking questions and defining problems** **Developing and using models**	**Structure and function** **Stability and Change** **Patterns** **Cause and Effect**

	SB2. Obtain, evaluate, and communicate information to analyze how genetic information is expressed in cells. **a. Construct an explanation of how the structures of DNA and RNA lead to the expression of information within the cell via the processes of replication, transcription, and translation.** **b. Construct an argument based on evidence to support the claim that inheritable genetic variations may result from:** ● **new genetic combinations through meiosis (crossing over, nondisjunction);** ● **non-lethal errors occurring during replication (insertions, deletions, substitutions); and/or heritable mutations caused by environmental factors (radiation, chemicals, and viruses).** **c. Ask questions to gather and communicate information about the use of ethical consideration of biotechnology in forensics, medicine, and agriculture.** **SB3. Obtain, evaluate, and communicate information to analyze how biological traits are passed on to successive generations.** **a. Use Mendel's laws (segregation and independent assortment) to ask questions and define problems that explain the role of meiosis in reproductive variability.** **b. Use mathematical models to predict and explain patterns of inheritance. (Clarification statement: Students should be able to use Punnett squares (monohybrid and dihybrid crosses) and/or rules of probability to analyze the following inheritance patterns: dominance, codominance, incomplete dominance.)** **c. Construct an argument to support a claim about the relative advantages and disadvantages of sexual and asexual reproduction.**		

NGSS Alignment	NGSS Alignment to Disciplinary Core Ideas
Weekly Lesson Tasks	

Week 1					
GSE:SB1b: Develop and use models to explain the role of cellular reproduction (including binary fission, mitosis and meiosis) in maintaining genetic continuity.	**Focused Concept:** **SB2b: Construct an argument based on evidence to support the claim that inheritable genetic variations may result from:** • **new genetic combinations through meiosis (crossing over, nondisjunction)** **SB3 a: Use Mendel's laws(segregation and independent assortment) to ask questions and define problems that explain the role of meiosis in reproductive variability.** **b. Use mathematical models to predict and explain patterns of inheritance. (*Clarification state: Students should be able to use Punnett Squares (monohybrid and dihybrid crosses) and/or rules of probability to analyze the following inheritance patterns: dominance, codominance, incomplete dominance.)***				
Phenomenon: How do parents have offspring who do not look like their parents?			**DQ: How does sexual reproduction result in greater genetic diversity among offspring?**		
	Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**
Learning Target	**I can compare and contrast asexual and sexual reproduction.**	**I can explain how new genetic combinations arise through meiosis.**	**I can use mathematical models to predict and explain patterns of inheritance.**	**I can use Punnett Squares and the rules of probability to analyze non-Mendelian patterns of inheritance (codominance, incomplete, etc).**	**I can use Punnett Squares and the rules of probability to analyze non-Mendelian patterns of inheritance (codominance, incomplete, etc).**
Opening (10-15 minutes) **Essential Vocabulary this week:** **asexual reproduction** **sexual reproduction** **meiosis** **crossing over** **nondisjunction** **homozygous** **heterozygous** **dominant** **recessive** **trait** **filial generation** **codominance**	**The teacher will share the see-think-wonder for genetics. Teachers will have students Think, Pair, and Share their ideas about what they notice about the images. They will also start a driving question board for students to share their thoughts and questions.**	**The teacher will pose the question "What could go wrong during meiosis?". Then, in small groups, students will be given a normal and an abnormal karyotype and asked what they see, what they wonder, and what they think about the karyotype.** **See Think Wonder** **Writing prompt- students should answer in a notebook.**	**The teacher will pose the question" How can we make predictions about which traits are inherited?** **Students will share ideas.**	**The teacher will show the see-think wonder and allow students to discuss the question, based on what we know so far. How would you explain how a child might not look like either parent?**	**The teacher will ask students which traits on the Smiley face genetics did not follow Mendel's Rules.** **Students will identify those traits and discuss how heterozygous individuals differ from homozygous dominant or homozygous recessive individuals.**

incomplete dominance polygenic sexlinked					
Guided Practice/ Transition (20 minutes)	**The teacher will ask students what type of cellular reproduction might explain how siblings might not look alike or even like their parents.** **In small groups, students will be given a diagram of binary fission, mitosis and meiosis and asked to figure out which type of cell reproduction based on the images might explain the phenomena.** ***Teacher will use this time to briefly review binary fission and mitosis, which were previously covered in unit 1*****.** **The teacher will provide direct instruction on phases of meiosis and the mechanisms of variation in meiosis and fertilization. Students will take notes.**	**The teacher will utilize the gradual release model to engage students in the Karyotype Gizmo with subject A.**	**The teacher will introduce the activity: Smiley Face and review key vocabulary genotype, phenotype, dominant, recessive, homozygous, and heterozygous.** **Students will work in pairs to complete parts A and B** **The teacher will give a mini-lecture on Mendelian Genetics and then ask students if all the outcomes on their Smiley Face follow Mendel's rules.** **The teacher will model how to set up and work Punnett square practice problems.** **Students will work on practice problems and the teacher will provide corrective feedback.**	**The teacher will give a mini lecture on non-Mendelian patterns of inheritance and introduce the Designing an Organism Lab (Chapter 12 Investigation A)** **Teachers will place students in small groups of 2-3.** **The teacher will reference the Smiley face lab from the previous day, model how students will determine traits, and complete the data table.**	**The teacher will model and demonstrate problems for each type of non-Mendelian pattern of inheritance.** **Students will follow along and work out the teacher's example problems in their notebook for reference.** **Key vocabulary:** **1. incomplete dominance** **2. codominance** **3. multiple alleles** **4. sex linked** **5. epistatsis**
Independent Practice (45-50 minutes) **Designing**	**TSW work on the Mitosis Meiosis Compare and Contrast.** **TTW facilitates while students work on the compare and contrast and provide corrective feedback, and reteach as necessary.**	**Students will complete and analyze the karyotype for subject B while the teacher monitors and provides corrective feedback.** **The teacher will model how to analyze the karyotype to determine the gender of the**	**Students will complete the analysis questions.**	**Small groups of 2-3 students will design an organism with three different physical traits and assign alleles for each trait. Determine the probability of each genotype and phenotype by constructing monohybrid crosses.**	**The teacher will divide the students into groups of 3-4. Each group will work on a practice problem with an assigned non-Mendelian pattern of inheritance (Section 12.4, pp. 371-375).** **1. Incomplete dominance**

		offspring. **The teacher will assign each student one subject (C, D, or E), and students will analyze the assigned karyotype via Gizmo and complete the Karyotype GRASPS writing assignment.**		**Students will complete the Analysis and Conclusion questions.**	**2. CoDominance** **3. Polygenic Traits** **4. Sex Linked Traits** **More than 1 group may be assigned to a topic. Each chart paper should include a sample problem indicating genotypic and phenotypic ratios. and a brief explanation of how that pattern differs from Mendelian patterns.** **The teacher will monitor students and ask probing questions, such as how the probability of inheriting a certain trait changes compared to traits that follow Mendelian rules.** **The teacher will provide feedback.** **Students will post their sample problems and do a round-robin to peer assess each group's work. Students can use sticky notes to leave feedback or questions as they peer review.** **Groups will go back and present to the class using the questions and feedback for guidance.**
Assessment Summary (5-10 minutes)	**Ticket out the door: How do crossing over, segregation and independent assortment provide evidence for increased genetic**	**Ticket out the door:** **TOD Genetics Questions** **Slide #1**	**Ticket out the Door:** **See Genetics TOD Slides**	**3-2-1** **Each student will share three things they learned so far, two things that they found interesting, and one thing they have a**	**Exit Ticket: pg 372** **Explain in your own words how incomplete dominance and codominance differ from what is called Mendelian**

	variation? pg 356 review question #2			question about.	inheritance, which involves dominant and recessive traits. The students will respond to the question by writing their response. The teacher will have students share their responses and clarify any misconceptions.
Small Group Tasks (TBA)					

Week 2					
GSE: SB3. Obtain, evaluate, and communicate information to analyze how biological traits are passed on to successive generations. SB2. Obtain, evaluate, and communicate information to analyze how genetic information is expressed in cells.		**Focused Concept: SB3b. Use mathematical models to predict and explain patterns of inheritance. (Clarifications statement: Students should be able to use Punnett squares (monohybrid and dihybrid crosses) and/or rules of probability to analyze the following inheritance patterns: dominance, codominance, and incomplete dominance. SB2a. Construct an explanation of how the structures of DNA and RNA lead to the expression of information within the cell via the processes of replication, transcription, and translation.**			
Phenomenon: How do parents have offspring who do not look like their parents? (Day 6 and 7) How can we slow the spread of a virus?			**DQ: How is genetic information transferred and regulated?**		
	Day 6	**Day 7**	**Day 8**	**Day 9**	**Day 10**
Learning Target	**I can use Punnett squares to analyze the inheritance pattern of codominance.**	**I can use mathematical models to predict and explain patterns of inheritance.**	**I can compare and contrast the structures of DNA and RNA and identify their role in genetic expression.**	**I can model how the processes of transcription and translation determine the amino acids in a protein.**	**I can explain how DNA and RNA lead to the expression of Sickle Cell via the processes of replication, transcription and translation.**
Opening (10-15 minutes)	**The teacher will (TTW) pose the question: Can blood type be used to determine paternity? TTW ask students to identify any patterns they**	**TTW explain to students that they've worked on problems that focus on one trait. What happens when there's more than one trait? Do the Punnett**	**TTW instruct students on the quiz before starting the lesson. TTW ask students what they notice about the images and how the**	**TTW ask students to share how they think DNA makes proteins based on the illustration on the See Think Wonder. Teachers will also ask**	**TTW ask students to share what they notice about the two images. Then the teacher will show the video and ask students why the blood**

	see in the See Think Wonder Slide.	Square rules still apply? What do you notice in image A and how does it differ from a traditional punnett square (image B)?	images relate to what we've learned previously. Then the teacher will introduce the phenomena: How can we slow the spread of a virus? TTW pose the question, how do you think the field of genetics can be used to help slow the spread of a virus? Students will share ideas on a driving question board.	students what organelles they think are involved in the process.	cells in people with sickle cell anemia come out misshapen.
Guided Practice/Transition (20 minutes)	The teacher will provide direct instruction via a mini-lecture on Multiple Allels (see page 372) and blood type inheritance. The mini-lecture will include the teacher modeling blood type inheritance problems. The students will take notes, follow along, and work on the sample problem with the teacher. Teacher Notes for Lab	The teacher will provide direct instruction to review Mendel's law of independent assortment. The teacher will model how to work out a dihybrid cross problem. Students will take notes and work on problems with the teacher in their notebooks.	The teacher will point out that all of the images involve nucleic acids. Then, the teacher will give a mini-lecture on the structure of DNA, base pairing rules, and RNA structure. Students will take notes. Suggestion: Use a compare and contrast chart. See Table 11.1 on page 321.	The teacher will give a mini-lecture on DNA replication, transcription, and translation. (Lecture should come after students have completed Explore activities)	The teacher will give a mini-lecture on how to read the amino acid charts. The teacher will model how to analyze the circle and traditional codon charts.
Independent Practice (45-50 minutes) Activity setup required for Day 9. Teacher instructions	Students will complete the Looking at the Data: Blood Type Compatibility assignment on page 370 of the textbook. Students will complete CER: ADI Lab 20 CER:ADI Lab 20 Modified Template	Students will review the Student Guide (Student Guide SB3b) and complete the accompanying Student Journal. The teacher will monitor, provide feedback, and answer questions as needed.	Students will take a quiz on the topics covered previously (20 minutes) before engaging with the see-think-wonder or mini lecture. After completing the quiz, students will work on Pivot Interactive: DNA to	The teacher will pass out the DNA Strand cards and mRNA strand cards. TTW explain the code from DNA has been taken from the DNA in the nucleus, out into the cytoplasm, and to the ribosome to prepare for translation.	Students will work independently to complete the Genetics of Sickle Cell Assignment. The teacher will monitor students, provide feedback, and answer questions.

			Proteins, completing part 1 before the teacher gives notes and then completing part 2 after the mini-lecture	**Students will complete part II of the Student Guide and Journal TTW will have students translate their mRNA into amino acids using the mRNA Codon Chart located in the part of the room labeled ribosome. Students will complete activity according to the directions in the Student guide and Journal. Student Guide:**	
Assessment/Summary (5-10 minutes)	**page 370 Looking at the Data activity question 3: Students will determine the offspring's blood type and identify all the family members who could donate blood. Students will answer on index cards. After collecting all the cards, the teacher will review the correct answer and provide clarification. *Homework: pg 378, questions 1-10***	**TOD: Slide #5**	**TOD: Slide #6 4 Corners- Students will move to the corner that matches what they think is the correct answer to the question.**	**TOD: Compare and contrast the processes of transcription and translation. Highlight at least three main differences.** ***Homework: Complete Pivote Interactive DNA to Protein Part 3.***	**TOD: Students will explain how someone with the sickle cell trait has both normal and sickle-shaped red blood cells.**
Small Group Tasks (TBA)					

Week 3	
GSE: **SB2. Obtain, evaluate, and communicate information to analyze how genetic information is expressed in cells.** **a. Construct an explanation of how the structures of DNA and RNA lead to the expression of information within the cell via the processes of replication, transcription, and translation.**	**Focused Concept:** **Mutations** **Genetic Technology**

b. Construct an argument based on evidence to support the claim that inheritable genetic variations may result from: • **new genetic combinations through meiosis (crossing over, nondisjunction);** • **non-lethal errors occurring during replication (insertions, deletions, substitutions); and/or** • **heritable mutations caused by environmental factors (radiation, chemicals, and viruses).**	

Phenomenon: How can we slow the spread of a virus?			**DQ: How does protein synthesis work with vaccine development?**		
	Day 11	**Day 12**	**Day 13**	**Day 14**	**Day 15**
Learning Target	**I can identify non-lethal errors during replication, such as insertions, deletions, and substitutions.**	**I can explain how mutations lead to changes in gene expression.**	**I can explain how genetic technology uses DNA or RNA to make vaccines.**	**I can explain how genetic technology uses DNA or RNA to make vaccines.**	**I can explain how gel electrophoresis is used to compare DNA samples.**
Opening (10-15 minutes)	**The Teacher will show the See, Think, Wonder and ask students how they think the images are related. Depending on the students' background knowledge, the teacher may also show the trailer for Five Feet Apart.**	**The teacher will show the See Think Wonder and ask the students what they notice about the pattern of inheritance. During the discussion, the teacher will remind students that DNA codes for particular proteins and that changes in DNA can lead to changes in proteins.**	**The teacher will have students start a KWL on vaccines. Students will share what they know about vaccines and how vaccines might be related to DNA and RNA.**	**The teacher will have students update their KWL on vaccines and ask students to discuss why we need a flu vaccine every year or why health officials suggest boosters for COVID-19.**	**The teacher will display the See Think Wonder and ask students what they notice about the Ancestry DNA Results.**
Guided Practice/Transition (20 Minutes)	**The teacher will assign groups of students to create posters on the types of gene mutations (frameshift and point-silent, missense, nonsense) and chromosomal mutations (translocation, duplication and inversion).** **See pages 358-360**	**The teacher will provide a mini-lecture on the types of mutations. Students will make corrections or add information from the previous lesson to the graphic organizer.**	**The teacher will discuss and show the video " How mRNA viruses work? from Learn Genetics Utah.**	**The teacher will give a mini lecture (7-10 minutes) on Vaccine Technologies, Influenza, and COVID-19 (pp. 410-413).** **Students will take notes.**	**The teacher will explain that today we're going to be genetic scientists, and we will learn how to analyze DNA results using Pivot Interactives Gel Electrophoresis Basics. The teacher will model how to access the Pivot Interactive Platform and help students complete part I**

Independent Practice (45-50 minutes) **Teacher Prep-** **Make copies of** • **Mutations graphic organizer** • **Mutation Pogil Modified** • **Modeling mRNA vaccine Teacher instructions**	**In small groups students will research their assigned type of mutation and create an infographic on chart paper. The teacher will monitor students and provide feedback as needed. Students will then fill out a graphic organizer on the types of mutations.**	**Students will use their notes and graphic organizer to complete the modified Pogil Activity. The teacher will monitor and provide feedback and correction as needed.**	**Using paper cutouts, students model the translation process to make a small piece of a coronavirus spike protein—the protein for which the mRNA vaccine codes.** **Students will discuss the following questions:** **Does a cell treat the mRNA from a vaccine differently from the mRNA the cell makes?** **Students will watch the "How mRNA Vaccines were engineered?" video.** **Student Instructions** **Cutouts**	**Using the notes and information presented in the previous lesson, students will complete the Revisit Viral Spread on page 419. They will work in pairs to answer the two questions on chart paper and then take notes.**	**Students will complete the Gel Electrophoresis activity on Pivot Platform.**
Assessment/Summary (5-10 minutes) **Genetics Exit Tickets**	**Ticket out the Door:** **The diagram shows a deletion mutation.**	**Ticket out the Door:** Which correctly identifies each type of mutation in the diagram?	**Ticket out the door;** **3-2-1** **Students will share three things they learned** **2- things they found interesting** **1- question they still have**	**TOD: How does the process of creating the COVID-19 vaccine differ from the process of creating the polio vaccine?**	**TOD: Who's the Daddy.**
Small Group Tasks (TBA)					

Week 4	
GSE: SB2. Obtain, evaluate, and communicate information to analyze how genetic information is expressed in cells.	**Focused Concept: Biotechnology and Genetics Review**

c. Ask questions to gather and communicate information about biotechnology's use and ethical considerations in forensics, medicine, and agriculture. **<u>SB3.</u> Obtain, evaluate, and communicate information to analyze how biological traits are passed on to successive generations.**					
Phenomenon: Weeds vs Plants			**DQ: Should people consume GMOs?**		
	Day 16	**Day 17**	**Day 18**	**Day 19**	**Day 20**
Learning Target	**I can ask questions to gather and communicate information about the use of biotechnology in agriculture.**	**I can analyze how biological traits are passed on to successive generations.**	**I can communicate information to analyze how genetic information is expressed in cells.**	**not applicable- Test Day**	
Opening	**The teacher will lead a discussion communicating about farmers and their crops. Students will generate a list of some of the challenges farmers face in a growing season. This list can be written on the board or in a shared document.**	**The teacher will review the See Think Wonder from week one and explain that today is a day to review standard SB3 and cell reproduction standard SB1b.**	**TTW will have students share on chart paper around the room how protein synthesis relates to vaccine development. This will allow students to revisit the previous phenomenon on vaccines.**	**The teacher will give general instructions on how to access the Genetics Unit Test.**	
Guided Practice/Transition	**The teacher will tell students they will model what happens in a cornfield when there are weeds present. Students will obtain information about what causes the weeds to spread in a farmer's field by modeling corn and weeds in the field. Students will notice that more weeds equals fewer corn plants, reducing the harvest and**	**TTW lead a series of review activities/ games for students to review material on Mendelian Genetics and other patterns of inheritance.**	**The teacher will introduce the Protein Synthesis STEMcase Gizmo. Students will assume the role of pediatricians investigating a disorder and the genetics behind it.**	**If the test is given via Illuminate, the teacher will model how to access the lockdown browser and ensure that the test conditions are similar to GMAS test conditions.**	

	profit for the farmer.				
Independent Practice	**After evaluating the effects of weeds in a corn field, students will pair up and discuss the effects of weeds on the farmer's crops. Then students will research and share why the farmer should or should not use GMOS or other biotechnology to combat the problem. Students will share on chart paper then do a round robin to see what other groups decided about the ethical use of GMOs or biotechnology in agriculture.**	**Students will explain which organelles are involved in the processes of meiosis.**	**Students will complete the Case study on their own. TTW monitor and answer questions as needed.**		
Assessment/Summary	**Students will complete a CER: How has GMO usage affected crop yields?**	**Students will complete open ended review questions.**	**TOD: Huntington's Disease**	**Students will take a Genetics unit test.**	
Small Group Tasks (TBA)					

Assessment Prep

Prepare students for assessment by reviewing the following Assessment Prep Presentation.
Genetics Assessment Prep Presentation

Provide the following guidance:
Ask the students to use what they know about the tasks completed to answer the provided assessment prep question.

- What is the question asking you?
- What do you know about the vocabulary or concept in the question?
- Is this question similar to any investigations or tasks we've completed?
- How can what you've done help you answer this question?
- Just view the assessment question: What is the question asking you?

Guide students to think about how their experience connects to the question.

Using the answer choices provided, ask the students the following:

- Identify a wrong answer: How do I know this answer is incorrect?
- Identify the right answer: How do we know this answer is correct?

Allow the students time to discuss in collaborative groups.

Labs / Investigations		
Mandatory Labs	**Explore Learning Gizmo**	**Pivot Interactives/Phet**
ADI Lab 20: Inheritance of Blood Type: Are all of Mr. Johnson's children, his biological offspring?	**Building DNA Gizmo** **Karyotype Gizmo** **Protein Synthesis StemCase**	**Gel Electrophoresis**

Additional Resources/Tasks	
Supplemental Resources	Meowsis Stemcase (Explore Learning)