CCPS Science Unit Plan

Grade	9-12	**Subject**	Biology	**Unit #**	4
Unit Name	Stability and Change in Ecosystems and Populations		**Timeline**	3 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					
Lesson Plan guidance document and template	Department of Science Guidance Document Lesson Plan Template Week View Biology Teacher Notes				

3Dimensional Instruction

GSE	Science and Engineering Practices	Crosscutting Concepts
SB5. Obtain, evaluate, and communicate information to assess the interdependence of all organisms on one another and their environment. **a. Plan and carry out investigations and analyze data to support explanations about factors affecting biodiversity and populations in ecosystems.** **(Clarification statement: Factors include population size, carrying capacity, response to limiting factors, and keystone species.)** **b. Develop and use models to analyze the cycling of matter and flow of energy within ecosystems through the processes of photosynthesis and respiration.** **Arranging components of a food web according to energy flow.** **Comparing the quantity of energy in the steps of an energy pyramid.**	**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**

	Explaining the need for cycling of major biochemical elements (C, O, N, P, and H). **c. Construct an argument to predict the impact of environmental change on the stability of an ecosystem.** **d. Design a solution to reduce the impact of a human activity on the environment. (Clarification statement: Human activities may include chemical use, natural resources consumption, introduction of non-native species, greenhouse gas production.)** **e. Construct explanations that predict an organism's ability to survive within changing environmental limits (e.g., temperature, pH, drought, fire).**		
NGSS Alignment	NGSS Alignment to Disciplinary Core Ideas		

Weekly Lesson Tasks

Week 1					
GSE: **SB5. Obtain, evaluate, and communicate information to assess the interdependence of all organisms on one another and their environment**	***Focused Concept: Energy flow (food webs, energy pyramids)*** **SB5b. Develop and use models to analyze the cycling of matter and flow of energy within ecosystems through the processes of photosynthesis and respiration.** • **Arranging components of a food web according to energy flow.** • **Comparing the quantity of energy in the steps of an energy pyramid.**				
Phenomenon: How do wolves change rivers?			**EQ: How do energy and matter move through an ecosystem?**		
	Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**
Learning Target	**I can gather evidence to help determine how sea pigs survive in the deep ocean.**	**I can use a model to analyze the flow of energy within an ecosystem.**	**I can classify organisms in an ecosystem according to their main ecological roles and their functions.**	**I can develop and use models to analyze the flow of energy by arranging components of a food web according to energy flow and**	**I can explain how factors affect population growth.**

			I can distinguish among the trophic levels of a simple ecosystem.	**comparing the quantity of energy in the steps of an energy pyramid.**	
Opening (10-15 minutes) **<u>Essential Vocabulary this week:</u>** **Food web** **Energy Pyramid** **Biomass** **thermodynamics** **biodiversity** **keystone species**	**The teacher will introduce the anchoring phenomenon:** **Guiding question: How do sea pigs survive in the deep ocean?** **See TB pages 28-29** **See think wonder: Slide 1** **Show students the Unit 1 video found in the ebook media library to build foundational knowledge.**	**The teacher will introduce the phenomenon for the week using the See Think Wonder Protocol. (The *teacher will remind students that as we go through the unit, we will continually add to our knowledge to help us answer our unit phenomenon question.)*** **Students will engage in a think-pair-share to determine what differences they notice, and what may have caused the difference. Student responses can be added to a driving question board.** **Day 2 Slide**	**TTW revisit the student driving question board from the previous day about what contributed to the changes between picture A and picture B. TTW guide students in a discussion to explain what might have caused the change in the ecosystem.** **Today, we will continue working on the Ecosystem Stemcase Gizmo.** **Refer back to Day 2 Slide**	**TTW, have students discuss what they notice about the three diagrams on Day 4's See Think Wonder. The teacher should ask students what patterns they notice in the images. What other science classes have they seen similar photos in? Students should discuss differences in shape, differences in units, etc. Students will do a think pair share before sharing ideas with the class. Students will write down observations in their notebook.**	**TTW share the See Think Wonder for Day 5 guiding the students to identify why the second fish bowl would be better than the first fish bowl.** **Students should share answers out loud and may write down their responses according to the teacher's direction. Sample answers- the 2nd bowl isn't as crowded.**
Guided Practice/ Transition (20 minutes)	**TTW have students list things they think they need to know about sea pigs to answer the driving question. TTW will support students' thinking by asking questions about organisms in the ocean that are familiar to the students.** **TTW will guide students to think about how the sea pig survives in its environment.**	**The teacher will introduce the Ecosystem Stemcase Gizmo to students.** **TTW discuss the background information along with components of the handbook with students.**	**TTW demonstrate how to calculate the amount of energy or matter transferred using the 10% rule.** **(Teachers should refer to the video "How Wolves Change Rivers" for clarification).**	**TTW will go over the safety procedures for Minilab- Model A biomass Pyramid on page 48 and put students in lab groups**	**The teacher will give a mini-lecture on logistic vs exponential growth, and density-dependent vs. independent variables.** **Students will take notes.** **Population Ecology Presentation**

	How do other organisms like starfish or oysters survive in the deep ocean? **How can we relate what we know about these organisms to the sea pig?**				
Independent Practice (45-50 minutes)	**TTW divides students into groups of 3 and ask them to read the case study "Something Fishy in the Forest" on page 33. After reading, student groups will create a food web using organisms mentioned in the case study and identify them as producers or consumers.** **Student groups will share their food webs by using the turn-and-talk strategy.** ***Note: This task is an opportunity to assess students' prior knowledge of relationships in Ecosystems*** **After students have completed the food webs,**	**Students will work through the handbook (20-30 minutes)** **After students have completed the handbook from the STEMcase, TTW give a mini-lecture on modeling the transfer of energy and matter (pg 38-46), discussing the ecological roles in ecosystems, food chains/food webs and ecological pyramids to clarify misconceptions students may have.**	**TTW give instructions on the next steps of the Ecosystem Stemcase Gizmo.** **TSW collect data to answer questions in the gizmo, identify, based on evidence, the keystone species for the ecosystem, and determine how the removal of that keystone species affects the biodiversity and health of the ecosystem.** **The teacher will circulate and ask guiding questions and clarify misconceptions as needed. TTW engage students in academic discourse as students progress through the STEMcase**	**TSW use mathematical models to represent how energy stored in biomass moves through an ecosystem.** **TTW facilitate the mini-lab on page 48, clarifying instructions as needed.** **Students will complete the results and analysis questions on page 48. (May be completed for homework if time runs out during class).**	**Students will complete the Predator-Prey Graph worksheet to analyze data related to relationships, carrying capacity, and limiting factors.** **Key:** **TSW complete 4.3 review page 99. The teacher will circulate and answer questions, referring students back to book, notes and lab results to help with understanding.**
Assessment Summary (5-10 minutes)	**TTW revisit the phenomenon and say "using the case study as**	**TOD: Ecology day 2**	**TOD: Slide 5 Assessment Prep presentation**	**TOD Ecology day 4**	**TOD Ecology Day 5**

	a reference, create an initial claim for the guiding question "How do Sea Pigs Survive in the Deep Ocean?		Suggested Homework: CER- Should Wolves be reintroduced to Yellowstone?		
Small Group Tasks (TBA)					

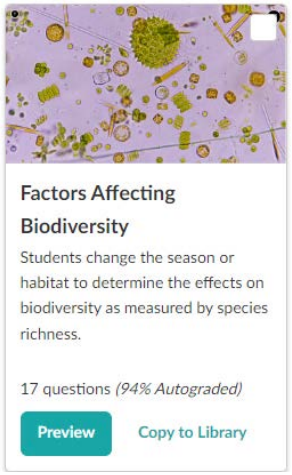
Week 2					
SB5. Obtain, evaluate, and communicate information to assess the interdependence of all organisms on one another and their environment	*Focused Concept: Biogeochemical cycles and Succession* SB5b. Develop and use models to analyze the cycling of matter and flow of energy within ecosystems through the processes of photosynthesis and respiration. • Explaining the need for cycling of major biochemical elements (C, O, N, P, and H) SB5d. Design a solution to reduce the impact of human activity on the environment. SB5c. Construct an argument to predict the impact on environmental change on the stability of an ecosystem.				
Phenomenon:			DQ: How do ecological disturbances affect an ecosystem's community of organisms?		
	Day 6	Day 7	Day 8	Day 9	Day 10
Learning Target	I can explain the need for the cycling of major biochemical elements (C, O, N, P and H).	I can use models to analyze the cycling of matter within ecosystems. I can describe major C, N, and P reservoirs and identify processes that move the nutrients between reservoirs.	I can describe major reservoirs of Carbon, nitrogen, phosphorus and water and identify processes that move the nutrients between reservoirs. I can design a solution to reduce the impact of human activity on biogeochemical cycles in the environment.	I can construct an argument to predict the impact of environmental change on the stability of an ecosystem focusing on secondary and primary succession.	I can develop an argument to explain how an ecological disturbance, such as a wildfire affects ecosystem stability and biodiversity.
Opening (10-15 minutes)	See Think Wonder Day 6 TTW ask students what they notice about the	See Think Wonder Day 7 TTW ask students if they would swim in the lake	TTW display the See Think Wonder from the previous day and	TTW display the Day 9 See Think Wonder and show the first 45 seconds	TTW display the Day 10 See Think wonder

Key vocabulary: **photosynthesis** **respiration** **aquifer** **reservoir** **biogeochemical** **transpiration** **denitrification** **eutrophication**	**structures of the four classes of biomolecules. Students engage in the turn-and-talk strategy with their elbow neighbor. Then, the teacher identifies select pairs to share. Students should notice that all four include the elements Carbon, hydrogen, and oxygen. Please review the See Think Wonder presenter notes for sample answers.** **(Have students refer back to any notes from SB1c if they are struggling to make connection)** **TTW ask the question "How does matter move through the ecosystem?)**	**in the picture and for students to explain their answer. Other guiding questions can include: " Why do you think the water is green? How did the lake get this way? Do you think humans were involved in the process which turned the lake green?"** **Students will write their answers in their notebook or on a shared discussion board as directed by the teacher. The teacher will call on a few students to share their answers.**	**ask the question which biogeochemical cycle or cycles are involved in what we observe in the picture.** **Students may identify water because it is a lake, however, teachers should ask probing questions such as what may have caused the overgrowth of algae which should lead all students to discuss whether nitrogen and phosphorus cycles may be involved due to the use of fertilizers or extra nutrients in the water. Students may also identify carbon cycles since the algae are carrying out photosynthesis.** **Students will engage in a think pair share and before sharing answers with the whole class.**	**of the linked video. Students will be prompted to answer in their notebook or according to the teacher's instructions the following questions:** **1. What happened to Mt. St. Helens in 1908?** **2. How do you think this impacted the ecosystems surrounding Mt. St. Helens? Why?** **3. How much biodiversity do you believe in the area around Mt. St. Helens after the eruption?** **4. What happened to the plants? Why?** **Students will share answers according to the teacher instruction and the teacher will ask additional probing questions as needed to help students understand ecosystems can redevelop after a natural disaster.**	**Students will share their ideas and then the teacher will pose the question: Are all wildfires always bad? and ask students to write down their answer on a sticky note with justification. Example, yes wildfires are always bad because they destroy people's property or No wildfires aren't always bad because the fire breaks down dead organisms.**
Guided Practice/Transition (20 minutes)	**TTW: provide a mini-lecture using the slides presented from the textbook on the four biogeochemical cycles, being sure to discuss the major processes involved**	**TTW briefly review the four biogeochemical cycles (carbon, hydrologic/water, nitrogen, and phosphorus).**	**The teacher will refer to the assessment prep section on the framework and follow the guidance provided. Students will answer questions and share**	**TTW provide a brief mini-lecture on succession Biology Ecological Succession Slides Students will take notes and ask clarifying**	**TTW introduce Tying it All Together task on page 79 in the textbook.** **TTW explain that students will obtain, evaluate, and**

	(e.g., photosynthesis, respiration, decomposition) TTW discuss key components (e.g., atmosphere, water bodies, soil) of the cycles TTW discuss the importance of the cycle in the ecosystem and human impact on the cycles Students will take notes using the Biogeochemical Cycle Graphic Organizer and ask questions.	TTW show a brief video on eutrophication and students will complete a Frayer Model Graphic Organizer Eutrophication in Florida Video TTW place students in groups of 3-4 and give each group a piece of chart paper. Students will divide the chart paper into 4 quadrants and for each cycle, student groups will brainstorm ways humans may impact each biogeochemical cycle. Student Scenarios	their answers. Please note that guided practice will take place after independent practice.	questions.	communicate information to develop an argument to explain how an ecological disturbance such as wildfires affect an ecosystem stability and biodiversity. TTW group students in pairs to complete the task.
Independent Practice (45-50 minutes)	TSW discuss and complete the "CCC - Cause and Effect" on page 54 with a classmate. They will use the Predict-Observe-Explain strategy to answer the CCC-Cause and Effect Question. Predict-Observe-Explain -Predict: Students predict what will happen in an experiment or scenario. -Observe: They observe the graph to identify trends and patterns -Explain: Students explain their observations,	In groups, students will work together to identify which cycle(s) are most affected by their assigned scenario. Each group will research the cycle and then design a solution to reduce human impact on the environment for the identified biogeochemical cycle.	In groups, students will complete their human impact and biogeochemical cycle assignment from the previous day. Students will share out round robin style where 1 randomly selected student will remain by the poster to share out. Students will rotate according to the teachers directions, asking clarifying questions and providing additional suggestions on how to reduce human impact for the given scenarios.	Students will use their knowledge of the types of success to create a timeline of secondary succession based on the students' school being abandoned. TSW also use the information and notes to predict the types of succession asked about on the worksheet. Succession Assignment *(Note: Teacher will insert school name when asked on the assignment.)* TTW circulate around the room and answer clarifying questions.	TSW close read the passage and complete Tying it All together task on page 79 in the textbook. TTW will circulate and answer clarifying questions.

	comparing them to their original prediction Suggested HW 2.4 Review questions 1-4 pg 55				
Assessment/Summary (5-10 minutes)	**Students will give a 1 minute elevator speech summary of what they learned about biogeochemical cycles.**	**Day 7 TOD**	**3-2-1 Students will reflect on the information shared and for the ticket out the door, students will write down 3 things they discovered, 2 things they found interesting and 1 thing they have a question about.**	**TOD: pg 81 questions 12 and 13. Homework: Succession Scavenger Hunt**	**TOD: Students will answer critical thinking question 12 on page 81. Use evidence from Figure 3-12 (pg 74) to support the idea that moderate disturbances actually enhance ecosystem stability.**
Small Group Tasks (TBA)					

Week 3					
SB5. Obtain, evaluate, and communicate information to assess the interdependence of all organisms on one another and their environment	**Focus Concept: SB5a. Plan and carry out investigations to analyze data to support explanations about factors affecting biodiversity and populations in ecosystems. (*Clarification statement:* Factors include population size, carrying capacity, response to limiting factors and keystone species.) e. Construct explanations that predict an organism's ability to survive within changing environmental limits (e.g., temperature, pH, drought, fire).**				
	Day 11	**Day 12**	**Day 13**	**Day 14**	**Day 15**
Learning Target	**I can analyze data to explain factors affecting biodiversity and populations in ecosystems.**	**I can analyze and interpret data to determine the effect of invasive species on population density.**	**I can plan and carry out an investigation to predict an organism's ability to survive in a changing environment.**	**I can collect and analyze data to construct an explanation to predict an organism's ability to survive in a changing environment**	**I can construct an explanation to predict an organism's ability to survive in a changing environment.**
Opening (10-15 minutes)	**Phenomena- If There is a Toxic Hammerhead**	**Opening: TTW ask the students to use the Turn**	**TTW share an image of range of tolerance and**	**TTW share the image of the range of tolerance**	**TTW share an image of a range of tolerance**

	Worm in Your Garden, Do Not Touch It! **Hammerhead Worms: What to Know** **The teacher will introduce the phenomenon using the See Think Wonder Protocol.** **Guiding Question: How does the Hammerhead Worm affect the biodiversity of Georgia's ecosystems?**	**and Talk Method to discuss the question " How do you think invasive species affect the carrying capacity of an ecosystem?"** **Slide 12** **TTW randomly select students to share answers aloud.**	**follow the See Think Wonder protocol for** **Slide 13**	**and ask students how their wonderings have changed from the previous day.** **Slide 14**	**graph. Teacher will ask students to make a prediction for today's lab about which solution will have less brine shrimp and also ask students which cellular process may contribute to the decrease we may see in the number of shrimp in various solutions.** **Please note this is a chance to revisit cellular transport. See The speaker notes for Slide 15.** **Slide 15**
Guided Practice/Transition (20 Minutes) **Lab Prep needed for this week**	**TTW model and walk students through questions 1-4 of Pivot Interactive: Factors Affecting Biodiversity. Students will listen and complete the questions as directed by the teacher.**  Factors Affecting Biodiversity Students change the season or habitat to determine the effects on biodiversity as measured by species richness. 17 questions *(94% Autograded)* Preview Copy to Library **Students will ask clarifying questions as**	**TTW show Figure 1 on page 102. The electronic figure can be accessed via the online textbook. TTW will have students utilize the See Think Wonder protocol as the teacher introduces the activity: Looking at the Data: Invasive Species Population Growth (pg 102).** **TTW guide students through reading and annotation. Students will read and share any words or words they do not understand. The teacher will help students use context clues to define any unfamiliar terms.**	**TTW organize students into lab groups of 3-4 students. Then the teacher will have each lab group work together to complete the pre laboratory assignment.** **Student groups will research the aquatic environment of the Great Salt Lake in Utah and on chart paper will list some of its biotic and abiotic factors.** **Students will identify some factors that could affect brine shrimp living in the Great Salt Lake.** **Brine Shrimp Investigation A:Teacher Notes** **Lab groups will use the information to**	**TTW review lab safety guidelines, and models how to collect the data for Day 2**	***Guided practice should take place after students collect data.*** **TTW: give a mini lecture on range of tolerance, carrying capacity, limiting factors and keystone species. Students will take notes.** **Population Ecology Presentation**

	needed.		**formulate a hypothesis about the effect of salinity on egg hatching and survival of brine shrimp.**		
Independent Practice (45-50 minutes) **Teacher Prep-lab Prep required** **Make the solutions for Brine Shrimp Lab. Salt solutions may be stored in the refrigerator or fume hood. They should be covered with a stopper or plastic wrap.**	**TSW work through the remaining questions on Pivot Interactive. The teacher will circulate around the room to monitor behavior and answer questions as needed.** **The teacher will randomly select students to share answers for the final pivot question.**	**TSW work with their partner to analyze data shown in the chart to identify patterns in the zebra mussel population density. They will interpret the data in light of the problem of invasive species population growth and use it to defend a potential solution. Students will answer questions 1-5 pg 102.**	**TTW give a tool talk and review safety procedures before lab groups complete the Day 1 Task.** **Student lab groups will work together to prepare the hatcheries according to the Investigation A.** **The teacher will make sure lab groups are following procedures and taking the necessary safety precautions.** **Students will observe each petri dish with a microscope or hand lens, count and record the number of eggs in Data Table 1 on Brine Shrimp Student Handout** **Students will Pour 30mL of each solution into the petri dish and place the labeled petri dishes in the designated area.** **Teacher tip: To Save time, teacher should prepare solutions before class.**	**TTW give a tool talk and reviews safety procedures.** **Students will follow the Day 2: Make Observations and Collect Data**	**TSW collect data according to the Day 3 procedures. Students will clean up according to the teacher and lab instructions.** **Then, students will use lecture notes and the data gathered to complete the analysis questions for the investigation.**
Assessment/Summary (5-10 minutes)	**TOD: After students complete the Pivot Interactive, students will predict how the**	**TOD Day 11: Students will use the 3-2-1 Template on Day 11 to share 3 three things they**	**TTW explain over the next few days we will determine the optimum conditions for brine**	**TSW answer the questions: Would you like to revise your prediction or hypothesis**	**TSW answer the following prompt (TOD Day 15):** Reflect on the data you

	presence of invasive hammerhead worms could affect the biodiversity of Georgia's pond ecosystems.	**learned, 2 things they found interesting and 1 thing they still have a question about.**	**shrimp and just like brine shrimp have ideal environmental conditions so do all living things. TSW answer the TOD for Day 13.**	**based on the data collected so far? Why or why not?**	collected and your understanding of the range of tolerance, briefly explain why fewer people live at the North Pole and South Pole compared to the number of people who live in areas closer to the equator.
Small Group Tasks (TBA)					

Week 4					
	Day 16	**Day 17**	**Day 18**	**Day 19**	**Day 20**
Learning Target					
Guided Practice/Transition					
Independent Practice					
Assessment/Summary					
Small Group Tasks (TBA)					

Assessment Prep

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

Ecology Assessment Prep

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.

TEACHER NOTE: If students struggle with the question, take time to review important concepts and clear up misconceptions. Do not rush to the next question.

Labs / Investigations		
Mandatory Labs	Explore Learning Gizmo	Pivot Interactives/Phet
Brine Shrimp Lab	Ecosystem Stemcase	Factors Affecting Biodiversity

Additional Resources/Tasks	
Supplemental Resources	Nitrogen Cycle Stemcase (Gizmo) Eutrophication Algal Blooms from Excess Nutrients Graphing Range of Tolerance Key Graphing Range of Tolerance