

I have chosen this unit since I will be able to implement art elements to my students over the next weeks and months in my current classes. If I use the current Pennsylvania standards, I am limited to using the middle school band listed for Grade 8 and the high school band for Grade 12 as the standards are very broad. This makes it relatively easy to integrate but does not have specific and measurable outcomes for each grade level. Currently, I have students in 7<sup>th</sup> grade up through 11<sup>th</sup> grade. This could change since students can be in our facility for a minimum 45 days up to the time they graduate, age-out, or drop out.

Pennsylvania's Standards are divided into 4 categories. I intend to use category 9.1. 8 and 9.1.12, Production, Performance and Exhibition of Dance, Music, Theatre and Visual Arts. Then the individual standard for the same grade bands 9.1.8.A and 9.1.12.A A. Know and use the elements and principles of each art form to create works in the arts and humanities.

- Elements
  - Visual Arts: • color • form/shape • line • space • texture • value
- Principles
  - Visual Arts: • balance • contrast • emphasis/focal point • movement/rhythm • proportion/scale • repetition • unity/harmony

As well as the individual standard B for the same grade bands.

Recognize, know, use, and demonstrate a variety of appropriate arts elements and principles to produce, review and revise original works in the arts.

- Music: • sing • play an instrument • read and notate music • compose and arrange •improvise
- Theatre: • stage productions • read and write scripts • improvise • interpret a role • design sets • direct
- Visual Arts: • paint • draw • craft • sculpt • print • design for environment, communication, multi-media

Additional Standards used will be:

- 9.1.8
  - o E. Communicate a unifying theme or point of view through the production of works in the arts. (modified gallery walk with 3D model)
  - o F. Explain works of others within each art form through performance or exhibition. (modified gallery walk and peer review)
  - o G. Explain the function and benefits of rehearsal and practice sessions. (reflection, revision, and modification due to peer review in “spy sessions”)
  - o H. Demonstrate and maintain materials, equipment, and tools safely. (PBIS behavior goals to be able to participate)
- 9.1.12
  - o F. Analyze works of arts influenced by experiences or historical and cultural events through production, performance, or exhibition. (reflection, revision, and modification due to peer review in “spy sessions”)
  - o G. Analyze the effect of rehearsal and practice sessions. (reflection, revision, and modification due to peer review in “spy sessions”)

- o H. Incorporate the effective and safe use of materials, equipment, and tools into the production of works in the arts at work and performance spaces. (PBIS behavior goals to be able to participate) (Pennsylvania Department of Education, 2002)

The above standards will work well with the adaptations and modifications, I have planned for this unit. In addition to the rooftop garden and green wall, I intend to add in a model of a 3D imaginary island that incorporates ecological principles as well as thematic information from the novel, *Lord of the Flies* (Golding, 2003). My students struggle with engagement and appropriate classroom behaviors. From the research provided in this class and personal experience with this population over 30 plus years of teaching, the Arts help students engage and retain academic information (Robinson, 2013). My plan is to add an art element of the final product at the place where the unit gives the building blocks for the entire system. I believe that by completing this in small but manageable chunks, my students will decrease adverse behaviors preventing them from participating in the “fun stuff” and increase student engagement and success.

## UbD Ecology with Arts Integration

Grade Level: 6 -12

Topic or Content Area: Biology: Ecology

Please list the Big Idea or Ideas:

- How can rooftop gardens or green walls promote biodiversity in ecosystems affected by human interaction?
- What happens if the water supply to an ecosystem is destroyed?

Stage 1 Desired Results	
ESTABLISHED GOALS <b>Summary:</b> In this unit, the students will be able to identify and understand the biotic and	<i>Transfer</i>
	<i>Students will be able to independently use their learning to...</i> <ul style="list-style-type: none"> <li>• Create and build a scale model of a rooftop garden or green wall to study the effects of biotic and abiotic factors.</li> </ul>

<p>abiotic factors of an ecosystem. They will identify and describe the roles that animals, plants and decomposers play in an ecosystem. The students will explore biological diversity to discover how and why certain species interactions are crucial to the health of the ecosystem. The students will conduct investigations to build an understanding of the interactions between plants, animals, and the abiotic factors in ecosystems. The investigations will include describing and comparing common ecosystems, determining the interactions of organisms within the ecosystem, and evaluating ways humans affect ecosystems. The unit involves an in-depth study of various ecosystems: first understanding biotic and abiotic factors, food chains and webs, process of biodegrading through composting, landfills, and sewage treatment facilities as well changes over time in a vivarium simulating a rooftop garden or green walls in preparation for building a green wall and/or rooftop garden at a local business park.</p> <p><b>NGSS Standards:</b></p> <ul style="list-style-type: none"> <li>• HS-LS1-5 From Molecules to Organisms: Structures and Processes: Use a model to illustrate how photosynthesis transforms light energy into stored</li> </ul>	<ul style="list-style-type: none"> <li>• Work cooperatively with a team of peers to create a company to market their garden/or wall presenting evidence to the viability of the project.</li> <li>• Create and build a rooftop or green wall for a local business to promote green spaces in an urban environment.</li> </ul>
<b>Meaning</b>	
<p><b>UNDERSTANDINGS</b> <i>Students will understand that...</i></p> <ul style="list-style-type: none"> <li>• the complex interactions of organisms depending on each other for survival keeps an ecosystem stable.</li> <li>• When an organism cannot do its job (niche), other organisms are affected.</li> <li>• Organisms exchange energy between themselves and the abiotic factors of the environment.</li> <li>• Organisms provide us with information on how to best mitigate human interaction that supports healthy ecosystems and biodiversity.</li> <li>• Organisms within an ecosystem adapt to the ever changing abiotic and biotic factors of the environment.</li> </ul>	<p><b>ESSENTIAL QUESTIONS- Label Facets</b></p> <p><b>Explanation:</b></p> <ul style="list-style-type: none"> <li>• Why are bee populations declining?</li> <li>• What relationships in an ecosystem would exist where a bird builds its nest in a thorn tree?</li> <li>• How does energy and matter flow through an ecosystem?</li> <li>• What is an ecological community?</li> <li>• What makes up an aquatic community?</li> <li>• How do we determine and identify the characteristics of populations in an ecosystem?</li> <li>• Why is biodiversity important?</li> </ul> <p><b>Interpretation:</b></p> <ul style="list-style-type: none"> <li>• Data Analysis: Why should we care about coral bleaching?</li> <li>• What might happen to plants if the Spotted Lanternfly continues to spread its influence in Pennsylvania?</li> <li>• How can computer models predict the effects of human interaction and climate change on an ecosystem?</li> <li>• What will be the effect of deforestation of the world's tropical rainforest on the percentages of oxygen and carbon dioxide</li> </ul>

chemical energy.

- HS-LS2-1 Ecosystems: Interactions, Energy, Dynamics: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- HS-LS2-2 Ecosystems: Interactions, Energy, Dynamics: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- HS-LS2-3 Ecosystems: Interactions, Energy, Dynamics: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
- HS-LS2-4 Ecosystems: Interactions, Energy, Dynamics: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- HS-LS2-5 Ecosystems: Interactions, Energy, Dynamics: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere,

in the atmosphere?

- Does an increase in overall global temperatures threaten biodiversity?
- What role is genetics playing in biodiversity and conservation of species?

**Application:**

- Why would you build a rooftop garden or green wall in an urban environment?
- How could we determine or estimate a population count of plants? ...of animals?
- What methods are used to conserve or preserve biodiversity in a system?

**Perspective:**

- How will climate change affect the way we live and prepare for the future?
- What do scientists consider as they describe differences in the regions of the world?
- What factors affect the growth of the human population?
- If the population of a species declines, will it affect the entire ecosystem?

**Empathy:**

- We are the land...Is the Earth the Mind of the people, and the people the mind of the earth?

**Self-Knowledge:**

- How do my actions or inactions affect the biosphere?

<p>hydrosphere, and geosphere.</p> <ul style="list-style-type: none"> <li>• HS-LS2-6 Ecosystems: Interactions, Energy, Dynamics: Evaluate the claims evidence and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions but changing conditions may result in a new ecosystem.</li> <li>• HS-LS2-7 Ecosystems: Interactions, Energy, Dynamics: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.</li> <li>• HS-LS2-8 Ecosystems: Interactions, Energy, Dynamics: Evaluate Evidence for the role of group behavior on individual and species' chances to survive.</li> </ul>		
<b>Acquisition</b>		
	<p><i>Students will know...</i></p> <ul style="list-style-type: none"> <li>• The segment of biology called ecology is the study of the complex interactions of organisms with the abiotic factors of their environment.</li> <li>• Explain the species' interactions in the complex food web that makes up an ecosystem.</li> <li>• Energy is cycled through the biosphere, atmosphere, geosphere and hydrosphere to support the ecosystem.</li> <li>• All organisms derive their energy and nutritional needs from other abiotic and biotic factors.</li> <li>• Key Vocabulary: abiotic, biotic, producer, consumer, decomposer, herbivore, carnivore, omnivore, detritivore, species, population, community, niche, biome, ecosystem, biosphere, geosphere, hydrosphere, atmosphere, photosynthesis, cellular respiration, food chain, food web, habitat.</li> </ul>	<p><i>Students will be skilled at...</i></p> <ul style="list-style-type: none"> <li>• Examining different ecosystems and identifying the biotic and abiotic factors and the role of each factor plays in the health of the system.</li> <li>• Determining evidence that supports their claims.</li> <li>• Justifying their reasoning using information from direct observation or research.</li> <li>• Using scientific tools and measurement to create a scale model.</li> <li>• Revising and editing claims and models to support evidence.</li> <li>• Modeling the flow of energy and nutrients through the spheres.</li> <li>• Describing the affect of human interaction on ecosystems.</li> </ul>

Stage 2 - Evidence	
Evaluative Criteria	Assessment Evidence
<p><b>Performance Tasks:</b></p> <ul style="list-style-type: none"> <li>• Content <ul style="list-style-type: none"> <li>A. Amount of content covered</li> <li>B. Quality of Research</li> </ul> </li> <li>• Creativity</li> <li>• Mechanics</li> <li>• Organization</li> <li>• Group participation</li> <li>• Length of presentation</li> <li>• Sources</li> <li>• Working model</li> <li>• Daily observations</li> <li>• Data tables</li> </ul>	<p><b>PERFORMANCE TASK(S):</b></p> <p>How can rooftop gardens or green walls promote biodiversity in ecosystems affected by human interaction?</p> <p>You are a member of the WHO Urban Green Space Team. Your team’s goal is to ensure the ability of the Earth to sustain life, maintain biodiversity, and promote the well-being of the human race. Your work on worldwide issues such as food insecurity, global warming, air and water pollution, deforestation, and overfishing to name a few. With this, you and your team decided to strengthen your goals through the use of multimedia resources and modeling.</p> <p>Your team decided to make a campaign video showing the different environmental issues that harm urban areas and model an urban rooftop garden or wall. The video presentation must be scientific, comprehensive, informative and persuasive so that people who will watch it will make a realization about the problems that we have created and the possible ways of correcting our mistakes through the use of the green space model. This video will be posted in youtube.com or other sites so that it will be accessible to all.</p> <p><b>Standards:</b></p> <p><b>Topic:</b> Ecology</p> <p><b>Materials:</b> depends on the needs of the students.</p> <p><b>Goal:</b> To make a video presentation that will show different environmental problems faced in urban areas and make a model of a green space solution.</p> <p><b>Role:</b> Members of WHO Urban Green Space Team.</p> <p><b>Audience:</b> Everyone</p> <p><b>Situation:</b> You and your team decided to make a video presentation that will enlighten the minds of people regarding the pressing problems in our environment and show a possible solution through modeling a rooftop or wall garden.</p> <p><b>Product, Performance and Purpose:</b></p> <ul style="list-style-type: none"> <li>• A video presentation will made by the students to promote awareness on the different environmental problems and the corresponding actions that we can do in order for us to prevent its further damage.</li> <li>• Design a working model of a rooftop garden or green wall to help with food insecurity, air quality, and other health effects.</li> </ul>

	<p><b>Standards and Criteria for Success:</b></p> <p><b>CRITERIA:</b></p> <p><b>Description:</b></p> <ul style="list-style-type: none"> <li>• 3 “interview” questions from each group member based on research Creative mode of interview</li> <li>• Each member has a summary of their specific job on the team (landscape architect, biologist, ecologist etc.)</li> <li>• Working Model</li> <li>• Data analysis of effects of the green space on simulated pollution reduction</li> <li>• Each group member must have equal participation</li> </ul> <p><b>Specific Requirements:</b></p> <ul style="list-style-type: none"> <li>• Video needs to be 10-12 minutes in length</li> <li>• 5 sources (at least) used for research</li> <li>• Working model</li> <li>• Define problem/topic</li> <li>• Include ways in which topic affects environment, man, other organisms, etc.</li> <li>• Discuss problems that might arise or have arisen based on your topic</li> <li>• Discuss ways in which the problem is being corrected today.</li> </ul>
<ul style="list-style-type: none"> <li>• Rubrics for detailed observations</li> <li>• behavior rubric 4 specific categories out of 6 behavior points to earn STEM and Labs</li> <li>•</li> </ul>	<p><b>OTHER EVIDENCE:</b></p> <ul style="list-style-type: none"> <li>• Kahoot quizzes</li> <li>• Journal of daily observations with photos</li> <li>• Data collection tables and analysis of geochemical cycles</li> <li>• Discussions</li> <li>• White board presentations (Claim, evidence, reasoning format)</li> <li>• Think, Pair, Share</li> <li>• Modified gallery walk</li> <li>• Diagrams</li> <li>• Bell Ringers/Exit Tickets</li> <li>• Daily behavior point sheets</li> </ul>

- End of unit test
- Vocabulary quizzes
- Laboratory reports

## Stage 3 – Learning Plan

### *Summary of Key Learning Events and Instruction*

Note: The lessons in this unit may take more than one 35-minute class period to complete.

#### **Lesson 1:**

- **Engage**
  - Students enter the room and begin their bellringer: The term of the week slide is showing on the whiteboard. Students write their definition of the word Ecology and give an example in the appropriate blank on the template.
  - Encounter the Phenomenon: Post on driving question board the Unit and Performance Task Phenomena question. Show photo of bird's nest in a thorn tree. Ask students why they think the birds built the nest in the tree. Hand out CER charts to students. Have students fill in the guiding question: What relationships in an ecosystem would exist where a bird builds its nest in a thorn tree? Add the guiding question under the phenomena question on the DQB. Give students 2 minutes to share with their partner and make a claim about the question.
- **Explore**
  - Show video excerpt of the ecosystem where birds build nests in thorn trees. Students add evidence to charts. If students have questions, they can add them to the driving question board. of ecosystem where birds build nests in thorn trees. Discuss the relationships and interactions of organisms.
- **Explain**
  - Give the pretest to assess student understanding and guide instruction.
  - Review the term of the week. Have students add the word ecology, the definition and a picture to their interactive notebooks.
- **Elaborate**
  - Start launch lab with wingless fruit fly adults. Students will attempt to answer the question if this were a reasonable way to study a real population of more complex organisms. Students will observe the flies over a week to see the entire lifecycle.
- **Evaluate**

- Exit ticket: describe one interaction you learned about in the video clip.

### **Lesson 2: Organisms and Relationships**

- **Engage**

- Students enter the classroom and complete the discussion question of the week on their bell ringer template. Give an example of a stimulus and response in an organism.
- Show slide of infographic “that’s life in the big city”. Think pair share discussion Introduce biotic and abiotic factors.

- **Explore**

- Have students look at a physical geography globe. In their teams have them determine possible differences in climate based on the patterns they see. Have them infer abiotic and biotic factors from the patterns. Have students explore biosphere interactive on Inspire Biology site.

- **Explain**

- Have students add biosphere, abiotic and biotic factors to interactive notebook.

- **Elaborate**

- Observe fruit fly cultures and make observations of changes in the system. Have students identify biotic and abiotic factors in the system.

- **Evaluate**

- Kahoot it for biotic and abiotic factors

### **Lesson 3:**

- **Engage**

- Students enter and complete bell ringer video journal. They respond to question, “Why should we care about Coral Bleaching?” after watching coral bleaching video clip.

- **Explore**

- Students complete Coral Bleaching data analysis lab. Answer questions on what causes coral bleaching?

- **Explain**

- Introduce limiting factors and range of tolerance. Begin Tolerance demo as per the p. 29 Inspire Biology TE (Biggs et al., 2020)
- Have students look at the data again. Think Pair Share.
- Complete Which student is right? Activity. Students evaluate two fictitious students’ ideas about coral bleaching. They enter their claim, evidence, and reasoning on the template.

- **Elaborate**

- Complete Observations of Fruit fly colony.

- Complete initial observations of tolerance demo
- **Evaluate**
  - Exit ticket Students write a question they still have about limiting factors or range of tolerance.

#### **Lesson 4: Levels of Organization**

- **Day one**
  - **Engage**
    - Students enter classroom and write their interpretation of the quote of the week on their bellringer template. "Health to the Ocean means health for us." Sylvia Earle Explain what the quote means in your own words. How does this apply to your life today?
  - **Explore**
    - Students gather notebook and pencil to go outside to observe biotic and abiotic interactions in the school yard. Have students make a list of all types of organisms and abiotic things they can see. Have them make a diagram that shows how the organisms on their list interact with each other. They need to be detailed. If students struggle with drawing, they may use words at this stage and then find pictures on the internet to insert in their diagram when they return to class. In the event of rain, a video clip of a temperate forest ecosystem will be used instead.
    - When the class goes back to the classroom, students will be asked to share their answers.
  - **Explain**
    - Ask the students to explain the existing relationship among the different organism and lead to them to the idea that "Everything is connected to everything else".
  - **Elaborate**
    - Make daily observations of fruit fly culture. Note any changes in the system. Introduce the idea of carrying capacity.
    - Make observations of tolerance demo (2 weeks to complete)
  - **Evaluate**
    - Exit ticket describe the limiting factors in your fly culture
- **Day Two**
  - **Engage**
    - Students enter classroom and write their interpretation of the joke of the week on their bellringer template.
    - Show video clip of Levels of organization <https://www.youtube.com/watch?v=u4DrP3WVNu8>
  - **Explore**
    - Make interactive graphic organizer for interactive notebook. Students take sheet of paper fold in half. On one half cut

6 tabs. On each tab student writes the level in order from smallest to largest: organism, population, community, ecosystem, biome, biosphere. On the opposite side the students draw or paste a picture of the word.

- o **Explain**
  - Have students develop a model to represent the levels of organization.
  - Use a modified gallery walk to present the models
- o **Elaborate**
  - Make daily observations of fruit fly culture. Note any changes in the system. Introduce the idea of carrying capacity.
- o **Evaluate**
  - Kahoot it on identifying which level of organization the picture fits.
- **Day 3:**
  - o **Engage**
    - Students enter the classroom and complete the term of the week on their new bellringer template. The word of the week is habitat and niche. Show the video clip <https://www.youtube.com/watch?v=pX433QZD77Y> have students write the definitions in their own words and give an example.
  - o **Explain:**
    - Show the students a log with shelf fungus on it. Ask how is the fungus using the branch? Discuss. Ask: what is one example of the niche of the fungus. Introduce concept of decomposer and symbiosis.
    - Show video clip on predation <https://www.youtube.com/watch?v=6jXwEOit5vM> discuss predator prey relationships from observations obtained during nature walk in the school yard.
    - Show video clip on symbiosis: <https://www.youtube.com/watch?v=zSmL2F1t81Q>
    - Discuss the three types of symbiotic relationships. Have students identify symbiotic relationships from nature walk observations. Complete matching interactive on McGraw Hill site.
  - o **Elaborate:**
    - Make observations of fruit fly culture (final) and Tolerance demo
    - Make inferences and write up a summary. Answer the question whether this would be a good way to study a population.
  - o **Evaluate:**
    - Lesson Check: online Inspire Biology

### **Lesson 5: Flow of Energy in an Ecosystem**

- **Day 1:**

- **Engage**
  - Add guiding question to the DQB How does energy flow through and ecosystem? Play launch the lesson video clip on the flow of energy.
- **Explore**
  - Virtual Investigation Model ecosystems
- **Explain**
  - Add in vocabulary words to interactive notebook: autotroph, heterotroph, herbivore, carnivore, detritivore, omnivore
- **Elaborate**
  - Make observations of tolerance demo
- **Evaluate**
  - **Kahoot** identify autotrophs, heterotrophs, herbivore, carnivore, omnivore, detritivore
- **Day 2:**
  - **Engage**
    - As students enter the room, hand them a card that they hang around their necks. Each card has an animal or plant that is in an ecosystem. Have students stand in a circle around the edge of the room. Explain that we're going to make a food web. Teacher has a ball of yarn and also wears an animal or plant. Teacher tosses the ball of yarn to something that eats the animal or plant. The process continues until the last student has the ball of yarn, or no more tosses can be made. Discuss what the students see in the connections.
  - **Explore**
    - Make groups of 2 - 3 students. Have each group of students model a food web from sets of picture cards.
  - **Explain**
    - Define trophic levels Have students construct ecological pyramids from teacher prepared data. Answer the following questions:
      - As you go up the pyramid, what happens to the amount of biomass at each trophic level?
      - As you go up the pyramid, what happens to the number of organisms at each trophic level?
      - As the trophic level increases, is there more or less energy available?
      - How do organisms in different trophic levels relate to each other?
      - If you add secondary consumers, how will it affect the system?
  - **Elaborate**
    - Make observations of tolerance demo

- **Evaluate**

- Reflection on labs

- **Day 3: Field day Exploring biomass**

- **Engage & Explore:**

- Students will meet outside in the school yard. Teacher will give each group
- Of students a brown paper bag, spring scale and quadrat. Students will toss quadrat count the different types of plants in their quadrat. One student counts as the other
- Writes the data. Students take a sample of the plant matter from a 10 square centimeter area and weigh it. After the return to the classroom students will calculate the biomass of their area.

### **Lesson 6: Cycling of Matter**

- **Engage:**

- Play video cycling of matter. Add the guiding question: How does matter flow through an ecosystem? to the DQB. Have students brainstorm how matter flows.

- **Explore:**

- Introduce the cycles in the biosphere with the interactives on the Inspire Biology site.
- Have the students do the Nitrogen cycle activity. Setup the 11 stations. Have students pick a starting point and use the stamp identifying that station on their passport. Have them roll dice and move to the corresponding station and marking their passport as they move through the cycle.

- **Explain:**

- Add vocabulary to interactive notebooks: matter, nutrient, biogeochemical cycle, water cycle, carbon/oxygen cycle, nitrogen cycle, phosphorous cycle.

- **Elaborate:**

- Make observations of the tolerance demo.
- Discuss nitrogen fixation, have students collect clover plants including the roots. Have them find the balls attached to the roots. Take a cross section of the balls and stain with toluidine dye. Have students examine the cross sections under the microscope and look for the nitrogen fixing bacteria stained red-violet.

### **Lesson 7: Communities, Biomes, Ecosystems**

- **Day 1: Communities**

- **Engage:**

- Add Why would you grow a Garden in a city? to the DQB. Have students write the term of the week, biome on their

templates. Watch the video clip: <https://www.youtube.com/watch?v=hlyOZlyPPDg> define the word biome.

- Ask students why you would grow a garden in a city? Guide them to use what they've learned about systems and cycles. Have them add any questions they might have to the DQB. Play the introductory video clip from McGraw Hill on a garden being an ecosystem.
- **Explore:**
  - Show powerpoint from Science Lessons that Rock. Have students do card sort for succession. Play the succession board game.
- **Explain:**
  - Add the following words to interactive notebook: Community, Primary succession, Secondary Succession, climax community.
- **Elaborate:**
  - Make observations of tolerance demo.
- **Evaluate:**
  - Have the students label a diagram primary succession, secondary succession and climax community.
- **Day 2: Terrestrial Biomes**
  - **Engage:**
    - Add guiding question: What do scientists consider as they describe different regions of the world? Hand each student a card as they enter the classroom with a different terrestrial biome on it. Play a video clip overview defining biome.
    - <https://www.youtube.com/watch?v=r8mQaxFzJH8>
  - **Explore:**
    - Webquest: Students will complete a webquest for the biome on their card. They will create an infographic about their biome's characteristics.
  - **Explain:**
    - Add the following words to students interactive notebooks: Weather, Latitude, Climate
  - **Elaborate:**
    - Make observations of tolerance demo
    - Virtual Lab Ecosystems, Organisms and Trophic Levels (Biggs et al., 2020)
  - **Evaluate:**
    - Kahoot Biome identification
- **Day 3 & 4: Terrestrial Biomes Continued**
  - **Engage & Explore:**

- Design your own biome activity: students will create a model biome and study the effects of abiotic factors on germinating plants. They are looking to answer the question, what impact abiotic factors have on a biome? Materials table will include sodium bicarb, 2 liter plastic bottles, plastic wrap, colored gels, electric fan, flower seeds, grass seeds, bean seeds, index cards, lamps, masking tape, potting soil, sand, clay, loam, scissors, small rocks, small beaker and test tubes, tape, water. Students will develop a hypothesis indicating the effect of the abiotic factor on the seeds. They will plan the experiment, writing each step following the rubric and have the plan checked by the teacher before building.
- **Day 5: Aquatic Ecosystems**
  - **Engage:**
    - Add the guiding question to the DQB. What are some examples and characteristics of aquatic communities? Watch the video clip on aquatic ecosystems from McGraw-Hill.
  - **Explore:**
    - Complete the virtual investigation communities and ecosystems where students set up a virtual reef tank and experiment with the parameters to make a healthy ecosystem. Discuss what went well and what didn't work well in the student systems.
  - **Explain:**
    - add vocabulary to the interactive notebook: sediment, littoral zone, aphotic zone, photic zone benthic zone.
  - **Elaborate:**
    - Make observations of tolerance demo and biome activity.
  - **Evaluate:**
    - **Kahoot** Aquatic zones

## Lesson 8: Population Ecology

- **Day 1:**
  - **Engage:**
    - Add the question Why are bee populations declining? Ask students why they think bee populations are declining and what effect it will have on ecosystems around the world. Think pair share activity. Play the video clip about the impact of global resource consumption on populations?
  - **Explore:**
    - A population of one activity Have the students in groups of 3 or 4. Give each student a different colored marker. Have them brainstorm and predict the meaning of the following terms writing their thoughts on chart paper. Population, population density, natality, mortality, emigration, immigration and carrying capacity. Set a timer for 10 minutes.

When the timer goes off have one student from each group present their findings.

- o **Elaborate:**
  - Make final observations of tolerance demo, analyze data and draw conclusions in a reflective paper. Make observation of biomes.
- o **Evaluate:**
  - Have the students answer the question, Is it possible to have a population of 1? Have them explain their reason
- **Day 2:**
  - o **Engage:**
    - Hand out KWL chart. Have the students look at the question, Why are bee populations declining? Ask them to fill in what they know on the chart. Have them write at least one question for what they would like to know. Watch the video clip on pesticide effects on a colony of bees from McGraw-Hill. Add in what they've learned from the clip to the KWL.
    - Play the video clip about the impact of global resource consumption on populations.
  - o **Explore and Explain:**
    - Have the students explore the interactives on population dynamics on the McGraw-Hill website. Discuss the graphs and analyze together. Apply the new knowledge to the carrying capacity of Nectar-Feeding Bats Graphing and data analysis activity. Students use the data tables provided by the teacher to graph and make inferences about the biotic and abiotic factors as well as the effect on the carrying capacity due to the factors.
  - o **Elaborate:**
    - Make observations of biomes
  - o **Evaluate:**
    - Identify the dependent and independent variable on a graph of population data.
- **Day 3:**
  - o **Engage:**
    - Have students pull out their KWL charts from yesterday. Watch the video clip and add to the learned column any new information <https://www.youtube.com/watch?v=K0QTlwwvrs>
  - o **Explore & Explain**
    - Virtual Investigation on Population Ecology. Students will explore the question: How does competition affect population growth? They will record observations and answer embedded questions in their science journals.
  - o **Elaborate:**
    - Collect data from biomes.

- o **Evaluate: Exit ticket**
  - Write one new thing you learned about bee populations.
- **Day 4-6:**
  - o **Engage:**
    - Ask students what an invasive species is? Watch the video clip on Australia's problem rabbits.  
<https://www.youtube.com/watch?v=e8pCXwWWNE0>
  - o **Explore: WhiteBoard Argument Day:**
    - Lab 9 from Argument Driven Inquiry Biology directions on page 126. Students will explore population growth by studying changes in the amount and nature of the plant life available in an ecosystem influences the herbivore population. Students will study the rabbit population at the Myxomatosis Trial Enclosure on Wardang Island, Australia. Students will use the online simulation Rabbits Grass Weeds to conduct their investigation. Students work in groups of 4. They need to come up with their investigation proposal. The students will prepare an argumentation whiteboard with the following categories. Guiding question, Group Claim, Group Evidence, and Justification for the evidence. Students will be given an opportunity to send one team member to "spy" on other teams asking questions and gaining information about other ways of approaching the task. Students will present arguments in a modified gallery walk. Peers will evaluate the work of each group. Each individual student will write a report based on the material in their presentation. (Sampson et al., 2014, p. 126)
  - o **Evaluate: peer review**
- **Day 7:**
  - o **Engage:**
    - Add the question, what factors affect human population growth? to the DQB Watch a video clip of Shibuya Crossing in Tokyo.
  - o **Explore & Explain:**
    - Lab: How can you show a population trend? Have the students culture bacterial colonies to track population growth, graph the collected data and compare and contrast the populations and factors. Students will use bacteria from their fingertips in this lab. Students will do the preparatory work for this lab. Petri dishes need to be inoculated and in the incubator by the end of the period. Students need to make their data tables and graphs with correct labels.
  - o **Elaborate:**
    - Make observations of biomes.
  - o **Evaluate:**
    - Evaluate factors: Students are given a graph with population trends. They use the data to predict how this factor will

affect the population in each country between now and 2050.

## Lesson 9: Biodiversity and Conservation

- **Day 1-4**

- **Engage:**

- Add the question What happens to this ecosystem if the river is destroyed? In small groups, have students brainstorm what would happen if the Susquehanna River disappeared. Watch the video clip from McGraw-Hill to introduce this concept. Term of the week is: Biodiversity. Students write the definition in their words

- **Explore & Explain:**

- Ask the question: Why is biodiversity important? Play video clip on the different phases of biodiversity.
    - [https://www.youtube.com/watch?v=GK\\_vRtHJZu4](https://www.youtube.com/watch?v=GK_vRtHJZu4)
    - White Board Argument Lab 11 Ecosystems and Biodiversity: Small groups of four students. How does food web complexity affect the biodiversity of an ecosystem? The purpose of this lab is to review food chains, food webs, and biodiversity. Students design and carry out an investigation using the Ecology lab from Annenberg Learner. Students explore the relationship between food web complexity and biodiversity in an ecosystem. Students will prepare the whiteboard for their argumentation session. They will use a modified gallery walk and peer review. Each student will write a lab report from the data collected. (Sampson et al., 2014)

- **Evaluate: peer review**

- **Day 5: Threats to Biodiversity**

- **Engage:**

- Show video clip of altered ecosystem. Think pair share for the question: How can the decline of one species affect an entire ecosystem?

- **Explore:**

- Hand each student a card with the picture of an endangered species on it. Have them research the animal and create an infographic, record a song or video about the animal or plant on their card outlining: how many are left in the wild, what is causing the extinction, habitat needs of the animal or plant, climactic conditions needed for survival, possible cause for decline in population and any other pertinent information. Use the online materials that explain the different types of effects such as extinction rates, overexploitation, habitat loss, fragmentation of habitat, pollution, invasive species, etc.

- **Elaborate: Evaluating Impacts of Environmental Change on Populations**

- Socratic seminar activity: Students research how the formation of the Isthmus of Panama and the anthropogenic construction of the Panama Canal changed local environments. Students attempt to answer the following questions

with their research to prepare for the Socratic Seminar. Would the separation caused by land formation lead to changes in a population's gene pool over time? How might the migration of organisms have impacted land populations in terms of speciation? What changes are currently being observed in fish populations of the Rio Chagres and Rio Grande Rivers? (Biggs et al., 2020)

o **Evaluate:**

- Rubric for socratic seminar

• **Day 6:**

o **Engage:**

- Students enter the room to find bus trays filled with leaf litter on their lab tables. Show the video clip on the spotted lantern fly <https://www.youtube.com/watch?v=Y5FqdEJoqew>

o **Explore and Explain: Survey Leaf Litter**

- Students will use observation with the eye and a hand lens to count the number of species visible and living in the leaf litter. They will calculate the index of diversity.  $IOD = \frac{\# \text{ of unique species} \times \# \text{ of samples}}{\# \text{ of total individuals}}$

$\# \text{ of total individuals}$

Which observed species are native or non-native to our region?

Infer the effects of the non-native species.

Hypothesize whether the IOD has changed over the last 200 years.

Discuss some of the problems associated with invasive species.

o **Elaborate:**

- Have students design a spotted lanternfly trap using the Engineering Design model.

• **Day 7: Conserving Biodiversity**

o **Engage:**

- Show Conservation video <https://www.youtube.com/watch?v=-u8xi7KFHY4>

o **Explore & Explain:**

- Field investigation: Explain that one of the jobs of a conservation biologist is to survey the land and provide an analysis of the health of an ecosystem. Take students outside and stake off a 15m x 15m area. Have them do an investigation of all the plant and animal life in the area. Have them take soil samples and analyze the samples with vernier probe ware. Have them look for any problems in the area and brainstorm solutions, decide a course of action. Guide the students into thinking about the rooftop or wall garden.

o **Elaborate:**

- Microbits design challenge: have the students use the microbits kits to design an oil spill cleaner upper. Follow the

engineering by design model with peer review.

o **Evaluate:**

- Peer Review

**Lesson 10: Performance Task Outlined in Stage 2**

- o Students will design a scale model of rooftop or wall garden for sustainability. The model that survives the winter will be built full scale in the spring on the school grounds.

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