STEM Curriculum Planning Guide

This instructional design guide serves as the template for the design and development of STEM units of instruction at the Dayton Regional STEM Center in Dayton, Ohio. The guide is anchored to the *STEM Education Quality Framework* also developed at the Dayton Regional STEM Center.

STEM Unit Title	**The Game of Life… Science**
Economic Cluster	Environmental Engineering
Targeted Grades	5
STEM Disciplines	Science, Technology, Engineering and Mathematics
Non-STEM Disciplines	English Language Arts and Fine Arts

Section I: STEM Unit Overview

Unit Overview

Students will learn the 5th grade life science content through a real-world problem: How can a game be designed that simulates the survival of plant and animal populations in an ecosystem as it undergoes environmental changes? Some of the changes that might occur are the introduction of a new population (including invasive species), the removal of a population, introduction of a virus, population crash and boom, competition, and changes due to natural disasters such as fire. Other concepts covered include energy transfer and food webs, symbiotic relationships, and predation.

Students will learn about other ecosystems by playing and evaluating other teams' games to provide feedback for revision in the design process.

Student teams will audition for a new show called "Apex Predator Den" by pitching their game designs to a panel of investors. Simulating the show, investors will each have a pool of funds to use to bid on the game(s) they think are the best. The team with the greatest investment wins the audition, earning the rights to appear on the season-premier of "Apex Predator Den".

Essential Question

How and why do organisms interact with the living and nonliving things in their environment, and what are the effects of these interactions?

Enduring Understanding

SCIENCE
All life is dependent upon the exchange of energy in an ecosystem because all life processes for all organisms require a continual supply of energy.

MATH
Representing problems algebraically and graphically are important skills in solving real world problems. Numerical expressions can be written to represent and solve real-world problems.

ENGLISH/LANGUAGE ARTS
Conducting research for a variety of reasons through print and digital resources, as well as representing your findings in a well written and organized manner using print or multimedia/visual components are vital skills for students facing a future in the 21st century.

Engineering Design Challenge

A new television show, "Apex Predator Den", is seeking young entrepreneurs! In their first episode, they are looking for the next big educational game to hit the market! They want kids to have fun while learning about ecosystems. Your task is to design a game, create a prototype, and audition to pitch your idea to a panel of investors on a kids' show inspired by Shark Tank. Your game must teach about organisms' roles in an ecosystem, how energy flows between them, food chains and webs, and the relationships between organisms. It must also demonstrate how changes in an ecosystem affect the populations of organisms that live there. The investors will be assessing the games and deciding in which ones they would like to invest, giving the opportunity to appear on the first episode.

Time and Activity Overview

Day	Time Allotment	Actvities
1	50 minutues	Pre-Test Review Ecosystems Vote on Ecosystems
2	50 minutes	Introduce Engineering Design Challenge Introduce Engineering Design Process Announce Teams Establish Career Roles
3	100 minutes	Ecosystem Relationships: Symbiosis, Predation and Competition

4	50 minutes	Energy Food Web
5	50 minutes	Oh Deer! Game
6	50 minutes	Oh Deer! Game Coordinate Graphing
7	100 minutes	Ecosystem Guided Research
8	100 minutes	Game Guided Research Introduce Ecosystem Game Rubric
9	200 minutes	Review Engineering Design Challenge and Process Introduce Ecosystem Games Guidelines Design & Build Prototype Games
10	100 minutes	Writing Game Instructions
11	100 minutes	Play Games and Provide Feedback
12	50 minutes	Redesign Games
13	100 minutes	Prepare Apex Predator Den Pitch
14	50 minutes	Apex Predator Den Simulation - Team Present Pitches
15	50 minutes	Review/Post-Test

Academic Content Standards

Pre-requisite Knowledge & Skill	Students should know the characteristics of ecosystems and be able to give examples of a variety of ecosystems. Students should know the roles of organisms and how they acquire energy in order to survive (producer, consumer, decomposer, herbivore, omnivore and carnivore). Students should be able to create and interpret food chains. Students should be familiar with graphing on a coordinate plane and with the term written expressions (i.e. “doubling the deer population of 12” can be written as 2 x 12).

Add Standard	**Mathematics**
Grade/Conceptual Category	5
Domain	OPERATIONS AND ALGEBRAIC THINKING 5.OA
Cluster	Write and interpret numerical expressions.
Standards	2. Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. For example, express the calculation “add 8 and 7, then multiply by 2” as 2 × (8 + 7). Recognize that 3 × (18932 + 921) is three times as large as 18932 + 921, without having to calculate the indicated sum or product.

Add Standard	**Mathematics**
Grade/Conceptual Category	5
Domain	GEOMETRY 5.G
Cluster	Graph points on the coordinate plane to solve real-world and mathematical problems.
Standards	2. Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

Add Standard	English Language Arts	
Grade	5	
Strand	Writing	
Topic	Research to Build and Present Knowledge	
Standard	7. Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. 8. Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.	

Add Standard	English Language Arts	
Grade	5	
Strand	Writing	
Topic	Presentation of Knowledge and Ideas	
Standard	4. Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace. 5. Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. 6. Adapt speech to a variety of contexts and tasks, using formal English when appropriate to task and situation.	

Add Standard	English Language Arts	
Grade	5	
Strand	Writing	
Topic	Production and Distribution of Writing	
Standard	4. Produce clear and coherent writing in which the development and organization are appropriate to task purpose, and audience.	

Add Standard	Social Studies	Ohio
Grade		
Theme		
Strand (pk-8 only)		
Topic		
Content Standard		

Add Standard	Science	Ohio
Grade	5	
Theme	Life Science	
Topic	Interconnections within Ecosystems	
Content Standard	Organisms perform a variety of roles in an ecosystem. All of the processes that take place within organisms require energy.	

Add Standard	Science	Ohio
Strand		
Course Content		
Content Elaboration		

Add Standard	**Fine Arts**	Ohio
Enduring Understanding	5	
Progress Points	Visual Arts	
Grade Level	Producing/Performing	
Content Statement	4 PR Select and use the elements and principles of art and design to communicate understanding of an interdisciplinary concept.	

Assessment Plan

What evidence will show that students have acquired the enduring understandings for this STEM unit?

Performance Task, Projects	Ecosystem Game Game Instructions Apex Predator Den Pitch/Slides Presentation
Quizzes, Tests, Academic Prompts	Ecosystem Pre/Post-Test Exit Slips Formative Assessments
Other Evidence (e.g. observations, work samples, student artifacts, etc.)	Coordinate Graph Symbiosis Sort Ecosystem Game Redesign Ecosystem Research Guide Game Research Guide
Student Self- Assessment	Game Evaluation Survey (completed by peers) Collaboration Rubric (completed by student and peers)

Technology Integration

ADISC Technology Integration Model*

	Type of Integration	Application(s) in this STEM Unit
A	Technology tools and resources that support students and teachers in ***adjusting, adapting, or augmenting*** teaching and learning to meet the needs of individual learners or groups of learners.	Pre-labeled/numbered Graph Calculators Ecosystem Research Websites
D	Technology tools and resources that support students and teachers in ***dealing effectively with data***, including data management, manipulation, and display.	Google Sheets/Excel Coordinate Graphing Website Calculators
I	Technology tools and resources that support students and teachers in conducting ***inquiry***, including the effective use of Internet research methods.	Computers/Laptops Ecosystem Videos
S	Technology tools and resources that support students and teachers in ***simulating*** real world phenomena including the modeling of physical, social, economic, and mathematical relationships.	Predator-Prey Simulation (Lotka Volterra Simulation) http://vlab.amrita.edu/?sub=3&brch=67&sim=185&cnt=1 Lotka Volterra Simulation Excel Spreadsheet Oh Deer!/Ecosystem Games
C	Technology tools and resources that support students and teachers in ***communicating and collaborating*** including the effective use of multimedia tools and online collaboration.	Slide Presentation
	**The ADISC Model was developed by James Rowley PhD, Executive Director of the Institute for Technology-Enhanced Learning at the University of Dayton*	

Career Connections

Career Description

Ecologists help people understand the connection between living things and their environment. There are many fields in ecology, including animal behavior, population biology, conservation biology. and marine ecology. Within these fields there are many amazing careers to pursue on land and sea. Ecologists must be really curious about how life works on earth.

Ecoinformatics Specialists use computers and other advanced technologies to manage the vast amounts of information that are gathered from scientific observation. Ecoinformatics is a pretty new field in ecology, and there are a lot of opportunities to apply computer skills like programming to help other ecologists and land managers organize their information and make sense of it.

Ecotoxicologists study the effects of chemicals or other stresses on plants and animals. Their research helps policy makers to set environmental standards so that humans do not release harmful chemicals into the environment. Ecotoxicologists usually have training in chemistry and physiology

Environmental Consultants look at the ecological impacts of development or conservation. They also recommend different methods to solve ecological problems. Environmental consultants may spend a lot of time outside, as well as writing reports and talking to policy makers, and they can work on many different types of projects.

Environmental Economists try to translate environmental issues into dollars and cents. It is pretty new for lawmakers to have to compare environmental costs to business costs when they are making decisions about conservation. Environmental economists can help to answer questions such as: how much is this land worth if we do not develop it?

Environmental Educators teach students and adults about nature, new discoveries, and the ecological problems we are facing today.

Environmental Lawyers specialize in legal issues that concern environmental problems, such as helping to find compromises between people who want land conserved for nature and those who would like to develop land for businesses.

Environmental Protection Specialists investigate the types and amounts of pollution humans create and find ways to prevent, control or fix the damage caused by that pollution.

Graphic Designers work on a variety of products and activities, such as websites, advertising, books, magazines, posters, computer games, product packaging, exhibitions and displays, corporate communications and corporate identity.

Independent Game Designers develop board games and pitch them to publishers to publish and market the game.

Professors teach at colleges, universities, and sometimes high schools. They also do research, and guide graduate and undergraduate students.

Program Managers find ways to use information from research assistants, research scientists, and professors to manage environmental resources and help policymakers understand the ecological problems we are facing today.

Research Scientists usually work in groups and come up with new questions, ideas and techniques to solve ecological problems facing the world today. These are the people that need research assistants to help them with their research.

Sales and Marketing Executives aim to maximize profits through developing sales strategies that match customer requirements and promoting products, services or ideas.

Science Writers write about scientific discoveries, issues, and problems. They write for magazines, newspapers, books and the web. Some science writers specialize in writing about the environment.

Section II: STEM Lesson Plan

Title of Lesson	**Lesson 1: Pre-Test and Ecosystem Review**
Time Required	50 minutes
Materials	Appendix A: Pre/Post-Test (1 per student) Appendix B: Pre/Post-Test Answer Key (1 for teacher) Appendix C: Ecosystem Voting Slip (1 per student) Computer with projector OR chart paper and markers Web-based videos: Biomes (approximately 4 minutes) http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/biomes.htm Ecosystems (approximately 3 minutes) http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/biomes.htm
Objectives	1. Students will show their knowledge of ecosystems by completing the Pre-Test. 2. Students will be introduced to the major biomes of the world (tundra, taiga, deciduous forest, desert, grassland, rainforest, marine, and freshwater). 3. Students will consider the difference between the terms biome and ecosystem. 4. Each student will choose their top three biomes that they are interested in selecting an ecosystem from in order to conduct research for the Engineering Design Challenge.
Instructional Process	1. Administer the Pre-Test to all students. Explain to the students that they are starting an exciting new unit called, “The Game of Life… Science.” Share that today’s goal is to learn how much they already know about ecosystems and to introduce the major biomes that exist in the world. 2. Show the class the video about the world’s major biomes (Biomes, approximately 4 minutes). 3. Show the class the video about ecosystems (Ecosystems, approximately 3 minutes). Lead a discussion about the difference between a biome and an ecosystem. A biome is a geographic area where specific species are able to survive due to the climate in that region. An ecosystem is a community where living and non-living things interact. Biomes are large ecosystems that contain many small ecosystems. 4. Explain to the students that throughout this new unit, they will be in charge of becoming an expert on one specific ecosystem. Distribute the Ecosystem Voting Slip and instruct students to list their top three choices of biomes, in order of personal interest. Once students are placed into groups, they may choose to research the biome as a large ecosystem, or narrow their choice into a smaller ecosystem. For example, a group assigned to desert may choose to specifically research the Sahara Desert, or a group assigned to freshwater may choose to research a pond in the deciduous forest. 5. After students have submitted their voting slips, groups students into teams of 3-4 based on interest to prepare for the next day’s lesson.
Differentiation	Provide testing accommodations as necessary. For students who may have difficulty writing, provide a typed list of the biomes for students to place the numbers 1-3 beside their top choices. Strategically arrange students into heterogeneous teams, as well as teams based on biome interest.
Assessments	Pre-Test Ecosystem Voting Slip

Section II: STEM Lesson Plan

Title of Lesson	**Lesson 2: Introduction to the Engineering Design Challenge**
Time Required	50 minutes
Materials	Computer with Internet access and projection capabilities Appendix D: Television Production Company Letter (1 copy - “prop” for teacher use) Appendix E: Engineering Design Process Image (1 copy per student or 1 copy digitally displayed) Appendix F: Career Roles (1 copy per team)
Objectives	1. The students will generate a list of questions that they need to answer in order to complete the Engineering Design Challenge. 2. The students will review the engineering design process and select career roles to use throughout the rest of the unit.
Instructional Process	1. Introduce Engineering Design Challenge by reading the Television Production Company Letter aloud to class to build student interest and promote inquiry. The letter can be displayed via computer projection and a hard copy can also be used by the teacher for authenticity. 2. Review the Engineering Design Challenge with students by displaying the Engineering Design Process Image. Discuss how it relates to the Engineering Design Challenge. 3. As a class, complete a “Need to Know” list. Act as the recorder while prompting students to develop a list of questions they need to answer in order to complete the Engineering Design Challenge. (For example: What are the different roles of organisms in an ecosystem? How is energy transferred between different roles?) Questions can be recorded on chart paper and displayed in the classroom throughout the unit, or typed in an electronic document that can be revisited throughout the course of the unit. This process represents the “questioning” phase of the engineering design process.) For more information on the Need to Know list visit http://bie.org/. 4. Announce ecosystem teams, as determined by the Ecosystem Voting Slips from the previous day. Give students time to discuss the option of narrowing their ecosystem. For example, students assigned to the rainforest biome may choose to research tropical rainforests or temperate rainforests. 5.Display a copy of the Career Roles and provide each team with a hard copy. Review each role and responsibility and allow teams to determine individual roles to be used throughout the remainder of the unit.
Differentiation	Use a KWL chart in place of the Need to Know list. For more information on the KWL chart visit http://www.readwritethink.org/classroom-resources/printouts/chart-a-30226.html Assign team roles based on student strengths.
Assessments	“Need to Know” list generated by students

Section II: STEM Lesson Plan

Title of Lesson

Lesson 3: Ecosystem Relationships (Symbiosis, Predation & Competition)

Time Required

100 minutes

Materials

Appendix G: Ecosystem Relationships Chart (1 per student)
Appendix H: Ecosystem Relationships Chart Answer Key (1 copy for teacher)
Appendix I: Symbiosis Sort1 (1 set of cards per team of 2-4 students; to re-use, print on cardstock, laminate, and cut apart)
Appendix J: Symbiosis Sort Answer Key (1 copy for teacher reference)
Appendix K: Symbiosis Ticket Out the Door (1 per student or electronic copy to project and/or read to students)
Computer with Internet access and projection capabilities

Biology 4 Kids Symbiosis Webpage
http://www.biology4kids.com/files/studies_relationships.html

Web-based videos:
BrainPop: Symbiosis (3:29 minutes)
http://www.brainpop.com/science/ecologyandbehavior/symbiosis/
YouTube: Symbiosis by Mark Drollinger (2:32 minutes)
https://www.youtube.com/watch?v=zTGcS7vJqbs
TEd ED Symbiosis - Clark's nutcracker and the whitebark pine (2:22 minutes)
http://ed.ted.com/lessons/symbiosis-a-surprising-tale-of-species-cooperation
TEd ED Parasite Talk - Jewel wasp and cockroach (7:12 minutes)
http://ed.ted.com/lessons/parasite-tales-the-jewel-wasp-s-zombie-slave-carl-zimmer History Channel - Laboratory video of jewel wasp and cockroach (4:56 minutes when started at 1:45)
https://www.youtube.com/watch?v=qN2XMyxAs5o

Objectives

1. Students will define symbiosis, predation, competition, mutualism, commensalism, and parasitism.
2. Students will give examples of each of the above relationships in an ecosystem.
3. Students will explain how both symbiosis and competition can benefit an ecosystem.

Instructional Process

1. Distribute the Ecosystem Relationships Chart.

2. Instruct students that they will be completing this chart over the next two days, as they find new information from videos and notes.

3. Have students sit in their teams to watch the following videos. After each video, have the students in the indicated Career Role (see below) lead their team in a discussion about the content. Then, have the discussion leaders to share their team's insights with the class and have students complete the applicable sections of their charts:

a. BrainPop: Symbiosis http://www.brainpop.com/science/ecologyandbehavior/symbiosis/ (3:29)
BrainPop requires a subscription. As an alternate, you can use:
YouTube: Symbiosis by Mark Drollinger (2:32)
https://www.youtube.com/watch?v=zTGcS7vJqbs
Discussion leader: Science Writer

b. TEd ED Symbiosis - Clark's nutcracker and the whitebark pine (2:22) http://ed.ted.com/lessons/symbiosis-a-surprising-tale-of-species-cooperation
Discussion leader: Graphic Designer

c. TEd ED Parasite Talk - Jewel wasp and cockroach (7:12) http://ed.ted.com/lessons/parasite-tales-the-jewel-wasp-s-zombie-slave-carl-zimmer
Discussion leader: Program Manager

d. History Channel - Laboratory video of jewel wasp and cockroach (start at 1:45; 4:56) https://www.youtube.com/watch?v=qN2XMyxAs5o
Discussion leader: Sales and Marketing Executive

4. Project the following website and guide students through the content as they take notes on their charts:
   a. Symbiosis Notes http://www.biology4kids.com/files/studies_relationships.html

5. Symbiosis Sort1 Activity - In teams, students apply what they have learned about symbiotic relationships:
   a. Divide class into teams of 2-4 students. (It is not necessary for teams to be the same as those for the Engineering Design Challenge.)

   b. Distribute a Symbiosis Sort card deck to each team.

   c. Instruct the students to work together with their teammates to sort the cards into three columns: Commensalism, Mutualism, and Parasitism. Teams should discuss each scenario to determine the type of symbiotic relationship represented. If there is any disagreement, students will need to justify their positions so their team can come to a consensus.

   d. The "+ / +," "+/-," and "+/0" cards are the symbols associated with each type of symbiosis. Have the students analyze these symbols and decide in their teams which symbol belongs with which relationship.

   e. Once the teams have correctly identified the symbols, have the students record them on their Ecosystem Relationships Charts.

   f. Discuss team classifications and Symbiosis Sort Answer Key.

6. Have students complete a Ticket Out the Door:
   a. Distribute blank tickets or have each student take out a sheet of paper.

   b. Project Ticket Out the Door.

   c. Collect tickets as students leave the classroom.

Grading:
Accept all reasonable answers. Sample responses:
Similarities - both animals use their mouths to remove their food from the trees; both animals bury some of their food to eat later.
Differences - Clark's Nutcrackers remove the seeds from the cones, but squirrels remove the entire pinecone from the tree; squirrels drop the cones on the ground and collect them, but the Clark's Nutcracker carries the seeds in its mouth and flies off to bury them.
Mutualism (Whitebark Pine provides food to the birds; Clark's Nutcracker plants seeds, aiding in tree's reproduction)

Differentiation

Symbiosis Notes:
Provide partially completed Ecosystems Relationships Charts.
Have students visit the website to complete the chart independently, rather than as a teacher-guided whole class activity.
Symbiosis Sort:
Reduce number of scenarios for students to analyze.
Have students research to find additional scenarios that describe symbiotic relationships and classify them.

Assessments

Teacher observation of team discussions during Symbiosis Sort
Ecosystem Relationships Chart
Ticket Out the Door

1Symbiosis Sort is adapted from Project WILD Terrestrial Student Pages, "Good Buddies" (http://www.projectwild.org/documents/projectwild.pdf)

Section II: STEM Lesson Plan

Title of Lesson

Lesson 4: Energy Food Web

Time Required

50 minutes

Materials

Appendix L: Food Web Organism Cards (1 organism card per student; to re-use, print on cardstock, laminate, and cut apart)
Yarn rolled into balls – various colors (5 to 10 balls of yarn)
Appendix M: Food Web Ticket Out the Door (1 per student or electronic copy to project and/or read to students)
Computer with Internet access and projection capabilities

Web-based video:
Study Jams: Food Webs
http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/food-webs.htm

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Objectives

1. Students will understand how energy is transferred in a food web.
2. Students will compare and contrast the difference between a food web and a food chain.
3. Students will explain what would happen to an ecosystem if one organism in that ecosystem was harmed or removed completely.

Instructional Process

1. Play the Study Jams:Food Webs video clip. http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/food-webs.htm

2. Lead a discussion about food webs after the video clip is over. The video has a “test yourself” quiz at the end that can be completed as a large group on an interactive whiteboard.

3. Pass out the Food Web Organism Cards, giving one to each student. Have students place the organism cards around their necks so that the card is facing out with the organism displayed. Students can also tape the organism card to their shirt. One student will have a “sun” card instead of an organism. (The sun can stand in the middle of the circle if you choose.)

4. Have students form a large circle around the room. Hand a ball of yarn to the sun and have that student pass the ball of yarn, holding on to the loose end, to one of the producers. The student with the producer card will then hold on to the yarn and throw the ball across the room to an organism that would get its energy from the producer. Lead conversations with the group about possibilities of where the ball of yarn could go next and discuss the energy flow. This will continue until the ball of yarn reaches an organism with no other organisms that would eat it. Point out that they just created a food chain, and that the ball of yarn demonstrated how the energy would flow through the food chain.

5. Share with the students that the sun doesn’t just give its energy to one producer, but all the producers. The “sun” will choose another producer to throw the ball of yarn to, and that food chain will continue.

6. Start a new ball of yarn with the sun over and over until all of the balls of yarn have been used a the students have created a giant web in the room. Point out that they have just created a food web, and that the food web is made up of multiple food chains all combined into one big web.

7. Discuss what would happen if one person were to drop their yarn connection. The whole web would become a mess and be affected. This is what happens to the balance of an ecosystem if an organism disappears, or is harmed in some way. All of the parts of a food web depend on one another.
Lead the discussion that some students are holding more than one color of yarn and are part of more than one

food chain.

Differentiation

For students who would have difficulty determining where the flow of energy should go next, the teacher can put a list on the back of each organism card telling what organisms might get their energy.
Students ready for a challenge can think of a decomposer that could be added to the food web and how it would be connected with the yarn.

Assessments

Food Web Ticket Out the Door

Section II: STEM Lesson Plan

Title of Lesson	**Lesson 5: Oh Deer! Game**
Time Required	50 minutes
Materials	Appendix N: Oh Deer! Game Instructions (1 copy for teacher) Appendix O: Oh Deer! Data Sheet (1 teacher copy for recording populations during game play)
Objectives	1. Students will represent several parts of an ecosystem and learn about habitat interactions. 2. By graphing the results of this game, students will visualize and interpret population dynamics, limiting factors, and carrying capacity. 3. Students will understand the basic needs for survival: food, water, shelter, and space. 4. Students will learn that limiting factors (eg: lack of food or water) or diseases can change animal populations. 5. Students will understand that populations change naturally.
Instructional Process	1. See Appendix N: Oh Deer! Game Instructions for detailed instructions on how to play the Oh Deer! Game and complete the Oh Deer! Data Sheet. 2. At the end of the lesson, students should meet in their ecosystem teams to discuss possible limiting factors that could affect populations in their ecosystem. This meeting should be led by the Program Manager. They should also reflect on today's lesson and share 3 things they learned with each other.
Differentiation	This game is appropriate for all levels. If there is a student who cannot run due to a disability, illness, etc. have her or him toss a Nerf ball from the sidelines at the running deer, roleplaying a car or a hunter. Any deer that get hit by the Nerf ball become a resource for the next round.
Assessments	Oh Deer! Data Sheet Informal Observations/Discussions

Section II: STEM Lesson Plan

Title of Lesson

Lesson 6: Oh Deer! Game With Coordinate Graphing

Time Required

50 minutes

Materials

Appendix P: Oh Deer! Graph (1 per student)
Completed Appendix O: Oh Deer! Data Sheet completed from previous lesson (1 per student or 1 copy digitally displayed)
Computer with Internet access (1 for every 2 students)
Appendix S: Oh Deer! Formative Assessment (1 per student)
Appendix T: Oh Deer! Formative Assessment Answer Key (1 copy for teacher)
Appendix Q: Mathematical Written Expression Practice (1 copy for each student, optional)
Appendix R: Mathematical Written Expression Practice Key (1 copy for teacher)
Web-based video:
https://www.youtube.com/watch?v=13tVl6RV3S4 (5:57 minutes)

Objectives

1. Students will practice coordinate graphing using the collected data.
2. Students will interpret the graph to discover what happened to the deer population and why.

Instructional Process

1. Discuss the game from yesterday.

2. Provide the data from Day 6 that was recorded on the Oh Deer! Data Sheet. This can be displayed digitally or have a copy provided for each student.

3. Have students plot the data on the Oh Deer! Graph. Students may need help placing the deer population on the Y axis and the years on the X axis.

4. Once students have finished the graph, have them watch the video on how to make a graph on Google Sheets: https://www.youtube.com/watch?v=13tVl6RV3S4 (5:57)

5. Have the students work with a partner to input the data into the Google Sheets.

6. Students will need to self assess their graphs by comparing them to the computer generated graph.

7. Finally, have students answer the Oh Deer! Formative Assessment questions individually. If students are struggling with mathematical written expressions, use the Mathematical Written Expression Practice handout as a review.

8. Discuss answers to the questions as a class as students correct individual papers.

Differentiation

Some students may need a graph pre-numbered and labeled. The amount of data can be cut down as well. Teachers may need to provide extra support for students having problems writing the mathematical expressions.

For higher levels, have students predict what will happen next and give explanations. They could also explore the concept of homeostasis in the ecosystem and how it is reached.
For an interactive Predator-Prey Simulation (aka Lotka Volterra Simulation) extension, students can visit the following website: http://vlab.amrita.edu/?sub=3&brch=67&sim=185&cnt=1

Assessments

The Lotka Volterra Simulation excel spreadsheet can also be used to demonstrate predator-prey population changes. This files can be shared with students or used a whole-class activity.
Oh Deer! Graph
Google Sheets Graph
Oh Deer! Formative Assessment

Section II: STEM Lesson Plan

Title of Lesson

Lesson 7: Ecosystem Guided Research

Time Required

100 minutes

Materials

Appendix U: Ecosystem Research Guide (1 per student)
Computers with Internet access

Helpful ecosystem research websites:
World Biomes and Ecosystems
http://www.ducksters.com/science/ecosystems/world_biomes.php
Welcome to Ecosystems for Kids
https://sites.google.com/site/bscsciencetreasures/ecosystems-1/ecosystems-for-kids
What's It Like Where You Live?
http://www.mbgnet.net/
Windows to the Universe
http://www.windows2universe.org/earth/ecosystems.html
Exploring Ecosystems
http://www.harcourtschool.com/activity/exploring_ecosystems/index.html

Ecosystem Non-fiction books:
(3-4 copies of each major ecosystem on various reading levels)
Lakes and rivers : a freshwater web of life by Philip Johansson
Freshwater Pond Biome by Shirley Duke
Life in Ponds by Lauren Coss
Rainforests by Louise Spillsbury
Rainforest Ecosystems by Tammy Gagne
Desert Food Chains by Angela Royston
Desert Habitats by Arnold Ringstad
Who Needs a Jungle? : A Rainforest Ecosystem by Karen Patkau
Jungle by Theresa Greenaway
The Temperate Forest: A Web of Life by Philip Johansson
Do You Really Want to Visit a Temperate Forest? by Bridget Heos
About Habitats: Grasslands by Catherine P. Sill
Grassland by Sean Callery
Ocean Food Chains by Angela Royston
About Habitats: Oceans by Catherine P. Sill
The forested Taiga : A Web of Life by Philip Johansson
Taiga by Trevor Day
Tundra by Peter Benoit
Tundra Food Webs by Paul Fleisher

Websites for Teachers:
Scholastic Ecosystems
http://www.scholastic.com/teachers/activity/ecosystems-11-studyjams-interactive-science-activities
Biology 4 Kids Symbiosis
http://www.biology4kids.com/files/studies_relationships.html

Objectives

1. Using multiple resources and research skills, students will gather information about their chosen ecosystem in order to gain knowledge about ecosystem changes for their game creation.

Instructional Process

1. Have students sit with team members during research time.

2. Hand out a copy of the Ecosystem Research Guide to each student. Each individual student will complete their own Ecosystem Research Guide and information can be shared between team members during game creation.

3. Review the Ecosystem Research Guide requirements and answer any questions students may have prior to researching.

4. Allow class time for students to use suggested websites and books to complete the Ecosystem Research Guide. Teammates may choose to work together when completing the Research Guide or to work independently to have more information to draw from when creating their ecosystem game.

5. If students do not finish ecosystem research by end of Day 9, have them complete it as homework.

Differentiation

Select leveled texts to support student research. For students who are struggling, reduce the number of research categories on the handout or allow students to work as a team instead of individually.

For students needing an extension, allow them to research additional examples of relationships and organism interactions found in the ecosystem.

Assessments

Ecosystem Research Guide

Section II: STEM Lesson Plan

Title of Lesson

Lesson 8: Game Guided Research

Time Required

100 minutes

Materials

Appendix V: Game Research Guide (1 per student)
Appendix W: Ecosystem Game Rubric and Content Score (1 per student)
Variety of Ecosystem Games (see Materials and Master Resource List for suggestions)
Blank paper to use for Ticket Out the Door

Objectives

1. Students will play ecosystem games for inspiration for their own designs.
2. Students will assess those games using the criteria for their engineering design challenge.

Instructional Process

1. Before the lesson, prepare enough games for the students in your class to play. You will need a game for every 2-3 students. There should be a variety of game types (board games with and without cards, online games, card games, physical activity games, etc.). The games should also represent a number of different ecosystems. Suggestions are provided in the Materials and Master Resource List.

2. Assign student groups of 2-3. These groups should include members of different teams, so that each team's members are exposed to different games.

3. Distribute and explain the Game Research Guide.

4. Assign each group a different game. Explain that students will be playing games to conduct research and inspire their game designs. As they play, students should complete the Game Research Guide. For games that require more than 2-3 players, group members may need to play multiple roles.

5. Allow time for students to play the games and complete the research guide. Circulate to answer questions and observe.

6. When groups have finished their guided research, ask the students how well they think the game they just played would satisfy the requirements for their game design assignment. Distribute the Game Rubric and Content Score handout* to each student. Explain that this is the rubric that will be used to grade their games.

*Please note that the Game Rubric and Content Score is designed to give students a total score out of 100. The first section scores the ecosystem game students created as a whole (worth 49 points). The second section scores the students' ability to incorporate content knowledge into the game (worth 51 points). All rubrics in this lesson have been formated to calculate a score out of 100.

7. Have students assess the game they played using the handout. Have groups briefly share the most important points from their research and assessment with the class.

8. Homework: Students should prepare a pitch to be presented to their team tomorrow. The pitch should include the type of game they want the team to create (board game, card game, online game, physical activity game, etc.), as well as any ideas they have for the concept of the game.

9. Have students complete a Ticket Out the Door:
   a. Distribute blank sheets of paper.
   b. Read the following prompt:
      Write your name and your Career Role (Project Manager, Science Writer, Graphic Designer, or Sales and

Marketing Executive) at the top of your ticket. Then, answer this question. Now that you are familiar with the rubric that will be used to grade your team's game, what do you think will be the most challenging part of this Engineering Design Challenge for you in your Career Role? Be sure to explain your thinking.

Differentiation

Assign games based on student needs and interests.

Assessments

Teacher observation
Game Research Guide
Ticket Out the Door

Section II: STEM Lesson Plan

Title of Lesson

Lesson 9: Teams Design & Build Prototype Games

Time Required

200 minutes

Materials

Appendix X: Ecosystem Game Guidelines (1 copy per student)
Appendix Y: Ecosystem Game Guidelines- Modified (1 copy per student, optional)
Appendix W: Ecosystem Game Rubric and Content Score (1 copy per student)
Appendix AB: Ecosystem Game Play Recording Sheet (1 per team)
Appendix U: Ecosystem Research Guide (completed from previous lesson)
Appendix V: Game Research Guide (completed from previous lesson)

Suggested game creation materials: (quantities will vary depending on type of games teams choose to create)
Posterboards/Game boards (1 per team)
Coloring utensils (1 set per student)
Scissors (1 per student)
Glue (1 per student)
Dice (1 set per team)
Spinners (1 per team)
Variety of movable game pieces (4 per team)
Sand timers (1 per team)
Index cards (1 pack per team)
Computers (optional, minimum 1 per team)

Objectives

1. Students will use their ecosystem research to develop a game for other students to play and learn about a specific ecosystem.

Instructional Process

1. Review the Engineering Design Challenge with students. Display and review the Engineering Design Process Image. Discuss how students are now entering the “design” phase of the Engineering Design Challenge.

2. Next, pass out a copy of the Ecosystem Game Guidelines to each student to help them during the design process.

3. Each group will create a game using the Ecosystem Game Guidelines that tracks the population of a species, from their specific ecosystem, over time. Students must decide what type of game they will create, what materials will be needed for their game, which details specific to their ecosystem will be necessary to play their game, and their players will need to record data from each turn on the Game Recording Sheet to show how certain events affected their population. Pass out one Game Recording Sheet per group so they can see how calculations will be recorded. Once the game is over, students will use the information from the Game Recording Sheet to create a graph that will show the changes that occurred to the population over the course of the game.

4. Allow students class time to work in teams and design games.

Differentiation

The Ecosystem Game Guidelines-Modified may be used for students who need a more structured/guided game building task.

Assessments	Ecosystem Game Rubric

Section II: STEM Lesson Plan

Title of Lesson	**Lesson 10: Game Design-Writing Instructions**
Time Required	100 minutes
Materials	Sample game instructions from a variety of board games (2-3 examples per team) (ecosystem game instructions from Lesson 8 may be used) Appendix Z: Game Instructions Checklist Appendix AA: Game Instructions Rubric
Objectives	1. Students will demonstrate clear and coherent writing by creating a detailed set of instructions to play the ecosystem game they have designed.
Instructional Process	1. Distribute copies of game instructions to each group. Ask students to discuss with their group the major components that should be included in their game instructions. It may also be helpful for students to refer to the Game Research Guide when selecting major components. 2. Each group will list their ideas on chart paper. As a class review all the lists, looking for similarities to create one unified list that mirrors the Game Instructions Checklist. 3. Distribute Game Instruction Checklist. 4. Allow class time for student teams to begin writing their game instructions using the Game Instructions Checklist.
Differentiation	Students can go to www.readwritethink.org to create a brochure for their game instructions, if time permits.
Assessments	Game Instructions Rubric Game Instructions Checklist

Section II: STEM Lesson Plan

Title of Lesson	**Lesson 11: Game Play and Peer Feedback**
Time Required	100 minutes
Materials	Appendix AB: Ecosystem Game Play Recording Sheet (1 copy per student, per game played) Appendix AC: Game Evaluation Survey (approximately 3 copies per student) Manila envelopes (1 per team) Completed ecosystem games designed by teams
Objectives	1. Students will evaluate quality game design by playing other students' games and filling out the survey form. 2. Students will learn about a variety of ecosystems by playing each others games.
Instructional Process	1. Have students set up their games and instructions so that they are ready to be played. Each game should have a supply of survey sheets available and a Manila envelope to put completed surveys in. 2. Students should travel in groups to other ecosystem games and play them. Each group will need a designated direction reader and all instructions should be read before game play begins. (You will need to gauge how much time to allow for each game playing session, but try to have students play at least 3.) 3. Students should fill out evaluation survey sheets on each game they play and leave the form at the game play station in the envelope. Be sure to stop students 5 minutes prior to switching to a new game to allow time to fill out the form.
Differentiation	Calculators may be used by students struggling with mental math/paper calculations.
Assessments	Game Evaluation Surveys Ecosystem Game Play Recording Sheet

Section II: STEM Lesson Plan

Title of Lesson	**Lesson 12: Redesign**
Time Required	50 minutes
Materials	Completed Appendix AC: Game Evaluation Survey (all copies that have been filled out by students who played the game) Appendix AD: Feedback Redesign Form (1 per team) Highlighters (1 per student)
Objectives	1. Students will explore the engineering design process by redesigning the game using the feedback provided by classmates.
Instructional Process	1. Have students take a few minutes to read peer evaluation feedback forms individually. 2. They should highlight things that need redesigned as they read. 3. Students should complete the redesign sheet as a team. 4. Students should redesign the games according to the feedback.
Differentiation	Working in heterogeneous groupings.
Assessments	Feedback Redesign Form Ecosystem Games

Section II: STEM Lesson Plan

Title of Lesson	**Lesson 13: Prepare Apex Predator Den Pitch**
Time Required	100 minutes
Materials	Computers to prepare slideshows (minimum 1 per team) Appendix AE: Apex Predator Den Pitch Planning Guide (1 per team) Appendix AF: Apex Predator Den Pitch Rubric (1 per team)
Objectives	1. Students will prepare a presentation to pitch their game to a panel of investors and audition for "Apex Predator Den".
Instructional Process	1. Show students the “Shark Tank” video clip(s) so they understand how the “Shark Tank” process works: Paper Box Pilots (11 minutes) https://youtu.be/x295EXgQDSE?list=PLUVRD8yY4HqmVMJAwy9eoXiBu6nzI_CcD Drip Drop (1:11 minutes) https://youtu.be/y5nmwuu6RX0 Smart Wheel (2 minutes) https://youtu.be/08mCf9G9xBU?list=PLUVRD8yY4HqmVMJAwy9eoXiBu6nzI_CcD. 2. Explain to students that they will be auditioning by pitching their games to a panel of investors. The investors have a set amount of money to invest in the games designed in the classroom. Explain that the audition process will mimic the investing process seen on the show. 3. Pass out the Apex Predator Den Pitch Planning Guide and the Apex Predator Den Pitch Presentation Rubric to each team. Review each handout with the students. 4. Teams will then work to plan their pitch to present to the investors. Teams will create Google slides to present their game (teams could also make a poster to present if technology is not available). Each team will create a name for their company/game, a logo, and a slogan for their product. Presentations should be no longer than 5 minutes per team. 5. Teams should practice their pitch and be prepared to audition.
Differentiation	Students can create a poster with their game information instead of creating a slideshow. Students who are ready for a challenge can think of a creative way to present their product information (song, jingle, poem, etc.) You may choose to have students determine the cost involved in creating their game. They would need to consider all of the materials they used to make their game: a. All physical costs of the game (e.g., cardboard, paper, etc.) b. All services costs for the game (e.g., printing papers, 3D printing, etc.) c. All boxing costs for the game (e.g., how big a box, packaging, etc.) Students could estimate how much they would charge for their game.

	Students could select which product, services, and boxing they will use (final). Students could determine how much they would charge for their game based on their final choices.
Assessments	Apex Predator Den Pitch Presentation Rubric Apex Predator Den Pitch Planning Guide

Section II: STEM Lesson Plan

Title of Lesson	**Lesson 14: Present Apex Predator Den Pitch**
Time Required	50 minutes
Materials	Prepared team presentations/Google slides Play money for investors to vote on the presentations (about five $10.00 bills per investor) Appendix AF: Apex Predator Den Pitch Rubric (1 per presentation)
Objectives	1. Teams will audition by pitching their games to a panel of investors and attempt to convince them to invest in their company/game and win the chance to audition for the first episode of "Apex Predator Den".
Instructional Process	1. Prior to class, compose a team of 3-6 adults to act as investors from Shark Tank Educational Media Productions (STEM Productions). Give each investor an equal amount of play money to use for investing in games. 2. Have teams take turns presenting to the panel of investors, as well as classmates. Presentations should be no longer than 5 minutes. 3. After listening to each of the teams' audition pitches, have investors award the play money to the team/teams with the best pitch. Investors can divide their money among teams however they see fit. 4. The team with the most money invested, that also meets the requirements of the rubric, will be the winning team.
Differentiation	Students that struggle during presentation may choose to create note cards with talking points prior to delivering their pitch.
Assessments	Apex Predator Den Pitch Presentation Rubrics

Section II: STEM Lesson Plan

Title of Lesson	**Lesson 15: Review/Post-Test**
Time Required	50 minutes
Materials	Appendix A: Pre/Post-Test (1 copy per student) Appendix B: Pre/Post-Test Answer Key (1 copy per teacher) Appendix AG: Collaboration Rubric (1 copy per student)
Objectives	1. Students will showcase their knowledge gained about ecosystems by completing the post-test. 2. Students will score themselves and teammates using the Collaboration Rubric.
Instructional Process	1. If needed, complete any Apex Predator Den presentations. 2. Hand out Post-Test and allow students time to complete the Post-Test. 3. Hand out Collaboration Rubric and allow students time to assess their teammates and themselves. Students should write each team member's name in one of the blank columns and assign points for each category, using the possible points listed. Note to students that the last category, "Research and Information Sharing," is weighted double. (It may be helpful to separate teams for this activity, so that team members cannot see one another's rubrics.)
Differentiation	Testing accommodations for students as needed.
Assessments	Post-Test Collaboration Rubric

Section III: Unit Resources

Materials and Resource Master List

Printable Resources:
Appendix A: Pre/Post-Test
Appendix B: Pre/Post-Test Answer Key
Appendix C: Ecosystem Voting Slip
Appendix D: Television Production Company Letter
Appendix E: Engineering Design Process Image
Appendix F: Career Roles
Appendix G: Ecosystem Relationships Chart
Appendix H: Ecosystem Relationships Chart Answer Key
Appendix I: Symbiosis Sort
Appendix J: Symbiosis Sort Answer Key
Appendix K: Symbiosis Ticket Out the Door
Appendix L: Food Web Organism Cards
Appendix M: Food Web Ticket Out the Door
Appendix N: Oh Deer! Game Instructions
Appendix O: Oh Deer! Data Sheet
Appendix P: Oh Deer! Graph
Appendix Q: Mathematical Written Expression Practice
Appendix R: Mathematical Written Expression Practice Key
Appendix S: Oh Deer! Formative Assessment
Appendix T: Oh Deer! Formative Assessment Answer Key
Appendix U: Ecosystem Research Guide
Appendix V: Game Research Guide
Appendix W: Ecosystem Game Rubric and Content Score
Appendix X: Ecosystem Game Guidelines
Appendix Y: Ecosystem Game Guidelines-Modified
Appendix Z: Game Instructions Checklist
Appendix AA: Game Instructions Rubric
Appendix AB: Ecosystem Game Play Recording Sheet
Appendix AC: Game Evaluation Survey
Appendix AD: Feedback Redesign Form
Appendix AE: Apex Predator Den Pitch Planning Guide
Appendix AF: Apex Predator Den Pitch Rubric
Appendix AG: Collaboration Rubric

Lesson Materials:
Computer with Internet access and projection capabilities
Chart paper and markers (optional)
Yarn rolled into balls – various colors (5 to 10 balls of yarn)
Game instructions from ecosystem board games (see suggestions below) or other sample instructions from a Variety of board games (2-3 examples per team)
Manila envelopes (1 per team)
Highlighters (1 per student)

Suggested Game Creation Materials:
(quantities will vary depending on type of games teams choose to create)
Posterboard/Game boards (1 per team)
Coloring utensils (1 set per student)
Scissors (1 per student)
Glue (1 per student)
Dice (1 set per team)
Spinners (1 per team)
Variety of movable game pieces (4 per team)
Sand timers (1 per team)
Index cards (1 pack per team)
Computers (optional, minimum 1 per team)

Web-based Videos:

Biomes (approximately 4 minutes)
http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/biomes.htm

Ecosystems (approximately 3 minutes)
http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/biomes.htm

Ecosystem Video Clips (approximately 8 minutes)
http://www.neok12.com/Ecosystems.htm

BrainPop: Symbiosis (3:29 minutes)
http://www.brainpop.com/science/ecologyandbehavior/symbiosis/

YouTube: Symbiosis by Mark Drollinger (2:32 minutes)
https://www.youtube.com/watch?v=zTGcS7vJqbs

TEd ED Symbiosis - Clark's nutcracker and the whitebark pine (2:22 minutes)
http://ed.ted.com/lessons/symbiosis-a-surprising-tale-of-species-cooperation

TEd ED Parasite Talk - Jewel wasp and cockroach (7:12 minutes)
http://ed.ted.com/lessons/parasite-tales-the-jewel-wasp-s-zombie-slave-carl-zimmer

History Channel - Laboratory video of jewel wasp and cockroach (4:56 minutes when started at 1:45)
https://www.youtube.com/watch?v=qN2XMyxAs5o

Study Jams: Food Webs
http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/food-webs.htm

Creating a Line Graph on Google Drive Spreadsheet (5:57 minutes)
https://www.youtube.com/watch?v=13tVl6RV3S4

Websites:
Scholastic Ecosystems
http://www.scholastic.com/teachers/activity/ecosystems-11-studyjams-interactive-science-activities

Biology 4 Kids Symbiosis
http://www.biology4kids.com/files/studies_relationships.html

Predator-Prey Simulation
http://vlab.amrita.edu/?sub=3&brch=67&sim=185&cnt=1

Ecosystem Research Websites:
World Biomes and Ecosystems
http://www.ducksters.com/science/ecosystems/world_biomes.php

Welcome to Ecosystems for Kids
https://sites.google.com/site/bscsciencetreasures/ecosystems-1/ecosystems-for-kids

What's It Like Where You Live?
http://www.mbgnet.net/

Windows to the Universe
http://www.windows2universe.org/earth/ecosystems.html

Exploring Ecosystems
http://www.harcourtschool.com/activity/exploring_ecosystems/index.html

Ecosystem Non-Fiction Books:
(3-4 copies of each major ecosystem on various reading levels)
Benoit, Peter. (2011). Tundra. Children’s Press.

Callery, Sean. (2011). Grassland. New York: Kingfisher.
Coss, Lauren. (2015). Life in Ponds. Mankato, MN: The Child's World.
Day, Trevor. (2010). Taiga. Raintree Publishers.
Duke, Shirley. (2013). Freshwater Pond Biome. North Mankato, MN: Rourke Educational Media.
Fleisher, Paul. (2008). Tundra food webs. Lerner Publications.
Gagne, Tammy. (2016). Rain Forest Ecosystems. Minneapolis, MN: Core Library an imprint of Adobo Publishing.
Greenaway, Theresa. (2004). Jungle. New York: DK.
Heos, Bridget. (2015). Do You Really Want to Visit a Temperate Forest?. Mankato, MN: Amicus Illustrated.
Johansson, Philip. (2008). Lakes and rivers: a freshwater web of life. Berkeley Heights, NJ: Enslow Publishers.
Johansson, Philip. (2004). The forested Taiga: a web of life. Berkeley Heights, NJ: Enslow Publishers.
Johannson, Philip. (2004). The Temperate Forest: a web of life. Berkeley Heights, NJ: Enslow Publishers.
Patkau, Karen. (2012). Who Needs a Jungle? : A Rainforest Ecosystem. Toronto: Tundra Books.
Ringstad, Arnold. (2014). Desert Habitats. Mankato, MN: The Child's World.
Royston, Angela. (2015). Desert Food Chains. Chicago, IL: Heinemann Library.
Royston, Angela. (2015). Ocean Food Chains. Chicago, IL: Heinemann Library.
Sill, Catherine P. (2011). About Habitats: Grasslands. Atlanta, GA: Peachtree Publishers.
Sill, Catherine P. (2012). About Habitats: Oceans. Atlanta, GA: Peachtree Publishers.
Spilsbury, Louise. (2016). Rain forests. Mankato, MN: Smart Apple Media.

Board Games Available for Purchase:
Ecosystems Themed Board Game
https://www.teacherspayteachers.com/Product/Ecosystems-Themed-Board-Game-Pre-Written-Editable-Cards-2293721

Food Web Collapse Game
http://www.amazon.com/V-Med-Supply-Food-Collapse-Game/dp/B00KM7GL9U/ref=sr_1_9?ie=UTF8&qid=1458404629&sr=8-9&keywords=food+web+game

Food Web Game
https://www.carolina.com/environmental-science-classroom-resources/food-web-game/443264.pr?question=food+web+game

The Whale Game - Survival at Sea
http://www.amazon.com/The-Whale-Game-Survival-Sea/dp/B002N4KTUM/ref=pd_sim_sbs_21_3?ie=UTF8&dpID=51f1esZnc7L&dpSrc=sims&preST=_AC_UL160_SR146%2C160_&refRID=1SDHMX89XE3TYEW4DFN1

Board Games Available for Free Download:
Extinction
https://www.angelo.edu/faculty/mdixon/ManEnvironment/extinctiongame.htm

Food Chain Checkers
https://www.windows2universe.org/teacher_resources/checkers_20march.pdf

Food Web Game
http://www.vanaqua.org/files/7113/2856/6547/4-7_Food_Web_Game_Lesson_Plan.pdf

Migration Game
http://www.birdday.org/pdf/migrationgame.pdf

Migration Game, Spanish version
http://birdday.org/pdf/migrationgamespanish.pdf

Race to Displace
http://schoolpartnership.wustl.edu/instructional-materials/race-to-displace/

There's No Such Thing As A Free Lunch
https://www1.maine.gov/dacf/php/integrated_pest_management/school-ipm-curricula/middle/documents/7_8iU2S1L2.pdf

Card Games Available for Purchase:
Chomp
http://www.amazon.com/Gamewright-217-Chomp/dp/B00005JS94/ref=pd_sim_328_18?ie=UTF8&dpID=5133TMHYB1L&dpSrc=sims&preST=_AC_UL160_SR134%2C160_&refRID=0VEZ63WM7R29QH9H1YE9

The Food Chain Card Game and Guide
https://www.amazon.com/Food-Chain-Card-Study-Guide/dp/B00JONKYOG

Into the Forest, Nature's Food Chain Game
http://www.amazon.com/Ampersand-Press-Forest-Natures-Chain/dp/B008HVKOH8/ref=pd_sim_sbs_21_1?ie=UTF8&dpID=51oG92QIuvL&dpSrc=sims&preST=_AC_UL160_SR160%2C160_&refRID=1SDHMX89XE3TYEW4DFN1

Krill - A Whale of a Game
http://www.amazon.com/Ampersand-Press-Krill-Whale-Game/dp/B005HYOOAG/ref=sr_1_1?ie=UTF8&qid=1458404039&sr=8-1&keywords=krill+game

Predator, The Forest Food Chain Game
http://www.amazon.com/Ampersand-Press-Predator-Forest-Chain/dp/B008HVKV12/ref=pd_sim_328_4?ie=UTF8&dpID=411QumcF%2BbL&dpSrc=sims&preST=_AC_UL160_SR160%2C160_&refRID=04ZPM9DE0DDNAPEFQXZM

Card Games Available for Free Download:
Changing Coral Reefs Game
Instructions
https://nmssanctuaries.blob.core.windows.net/sanctuaries-prod/media/archive/missions/2010aquarius/changing_coral_reef.pdf
Cards
http://sanctuaries.noaa.gov/missions/2010aquarius/coral_cards.pdf

Phylo Educational Ecosystem Trading Card Game - Base Deck and 5 Expansion Decks
https://www.teacherspayteachers.com/Store/Classventure

Online Computer Games:
Bacteria Simulator 2
http://www.freeworldgroup.com/games9/gameindex/bacteriasimulator2.htm

Bacteria Simulator 1
http://www.freeworldgroup.com/games9/gameindex/bacteriasimulator.htm

Rat Attack
http://www.pbs.org/wgbh/nova/education/activities/3603_rats.html

Feed the Dingo: An Ecosystem Game
http://www.pbslearningmedia.org/resource/plum14.sci.life.feeddingo/feed-the-dingo-an-ecosystem-game/

Food Fight
https://www.brainpop.com/games/foodfight/Ecogame.swf

Physical Activity Games:
The Food Web Game
http://www.k12.wa.us/science/ProfDev/TheFoodWebGame.doc

Survival Game
http://www.collectionscanada.gc.ca/eppp-archive/100/205/301/ic/cdc/science/english/bio/projects/foodchan.html

Key Vocabulary

Biome- a large ecosystem defined by a group of plants and animals that are able to survive in a specific geographic area

Carrying capacity- the maximum population (i.e. deer) that an area will support without undergoing deterioration

Carnivore- an animal that eats other animals

Climate- weather patterns in an area over time

Commensalism- a relationship between two kinds of organisms in which one obtains food or other benefits from the other without damaging or benefiting it

Consumer- a living thing that must eat other organisms to obtain energy

Competition- is an interaction that occurs among organisms whenever two or more organisms require the same limited resource

Decomposer- a living thing (i.e. bacteria, fungus, or insect) that feeds on and breaks down plant and animal matter into simpler parts or substances

Ecosystem- a community of interacting plants and animals and the environment in which they live

Endangered species- a species of animal or plant that is at risk of extinction

Energy- Every organism needs to obtain energy in order to live. For example, plants get energy from the sun, some animals eat plants, and some animals eat other animals.

Food chain- a series of organisms in which each one uses the next lower member of the series as a source of energy

Food web- interacting food chains in an ecosystem

Herbivore- an animal that only eats plants

Invasive Species- a species that is non-native to an ecosystem, usually causing the ecosystem food web to become unbalanced

Limiting factor- something that prevents a population from expanding

Mutualism- a relationship between two or more organisms where both organisms benefit

Omnivore- an organism that eats plants and animals

Organism- a living thing

Parasitism- a relationship between two organisms in which a parasite benefits from a host and the host is harmed

Photosynthesis- the process by which plants make their own food by taking in water, carbon dioxide and sunlight and producing oxygen and sugar

Population- a group of a particular species in an area

Predation- the act on one animal killing and eating other animals

Predator- an animal that lives by killing and eating other animals

Prey- an animal that is hunted or killed by another animal for food

Producer- a plant that uses the sun's energy to make it's own food

Relationship- the way in which two or more people or things are connected

Species- a group of animals or plants that are similar and can reproduce

Technical Brief

This lesson, in a nutshell, involves having students learn the biology behind food webs (and their constituent parts including: environments, predators, prey, consumers, producers, etc.) by designing a game. Differing environments vary drastically even when they seem similar. Take for example forests. A forest in the Pacific Northwest is certainly different from a forest in the Amazon. In each environment there are different animals and different ways these animals interact in both food chains and food webs. Through the design of a game, students will not only put their practical biology skills to use, but they will also apply their knowledge to make a fun and educational game.

So what is a game? The simple dictionary definition of a game is: “a physical or mental activity or contest that has rules and that people do for pleasure”[1]. However, a more complex definition is: “a (1) : a physical or mental competition conducted according to rules with the participants in direct opposition to each other (2) : a division of a larger contest (3) : the number of points necessary to win (4) : points scored in certain card games (as in all fours) by a player whose cards count up the highest (5) : the manner of playing in a contest (6) : the set of rules governing a game (7) : a particular aspect or phase of play in a game or sport <a football team's kicking game>”[1]. From this definition, we can see that a game is more than just an activity, it can have teams, points, rules, etc. In fact the history of “what is a game” is still debated among philosophers (see the Wikipedia.com page on “Games”[2] for a philosophical discussion and further delineation of the myriad of types of games.

A fair question to ask is whether one can actually learn from a game. Done correctly, one could teach in a game without the player knowing it! For example, even simple physical games tend to have strategy (e.g., Billy always turns left when escaping “it” in tag so if I am “it” I know what Billy does). Further, when roles and rules are assigned to games, players often learn as they take on those roles. In designing a game, there are many aspects to consider such as: “What type of game will I design?” (i.e. board, card, role playing, combination). For a good overview see the Wikipedia.com page on “Game Design”[3], where many versions of game types are discussed. Further, there is ample discussion on what is needed to design a game such as: tools, rules, game type, turn type, victory conditions (how does one know if the game is over?), story line (why should I play?), etc. In terms of designing a game and having roles, students might think that an educator needs to be involved to design an educational game, but there are other key players including: gamers (those who play games and enjoy the creation of new games), graphic artists (to make the game look aesthetically pleasing), and in the case of this lesson, a marketing person is needed to determine how to make the game and sell it so the profit margin is best for the company. All of these career roles are needed in this lesson.

[1] http://www.merriam-webster.com/dictionary/game
[2] https://en.wikipedia.org/wiki/Game
[3] https://en.wikipedia.org/wiki/Game_design

Safety and Disposal

There are no hazardous materials or major safety concerns for this lesson. Students are encouraged to recycle any waste that may be generated through the creation of their ecosystem games.

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Section IV: Appendices