SCIENCE INVESTIGATIONS

ECOLOGY PROJECT

Design a Zoo Exhibit for Your Ecosystem

Habitat • Community • Niche • Limiting Factors • Adaptations • Food Chains

GRADES 5-8

Includes Student Packet, Teacher Guide & Answer Key Notes

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Teacher Guide

At a Glance

Subject	Life Science: Ecology
Grade Band	Grades 5-8
Time	1 to 2 weeks of class periods (research, build, present)
Format	Team project (2 to 4 students). Each team designs a zoo exhibit display for one population and presents it to the class.
Optional Upgrade	FabLab Upgrade: students 3D print their population and an enlarged model of its adaptation feature for the exhibit.

Overview

Your students are co-directors of the Palm Beach Zoo. The National Zoo in Washington, D.C. has awarded the zoo a grant to build a new exhibit, and the exhibit will be the main attraction. Each team selects an ecosystem, picks one population (a plant or an animal), researches its habitat, community, niche, limiting factors, and adaptation features, and builds a display that educates visitors on that ecosystem. Teams must also include a predator-prey relationship, chart the producers and consumers in the community, and describe how energy and mass flow through the ecosystem.

The scenario does the classroom management for you: every required element is something a real exhibit would need, so students understand why each piece is on the checklist.

Learning Objectives

Students will be able to:

- Describe the habitat of a chosen population and the community of organisms that shares it.
- Explain the population's niche, its role in the community.
- Identify two living and two nonliving limiting factors and explain how each affects the population.
- Give an example of a predator-prey relationship in the ecosystem.
- Build a food chain of four organisms beginning with a producer, and chart producers and consumers.

- Describe at least one adaptation feature and how it helps the population survive.
- Explain how energy and matter flow through the ecosystem, including where new energy enters and where energy is lost as heat.

Standards Alignment

Standard	Connection
NGSS MS-LS2-1	Analyze and interpret data on resource availability and population effects (limiting factors research).
NGSS MS-LS2-2	Construct an explanation of predator-prey and other interactions in the ecosystem.
NGSS MS-LS2-3	Develop a model of energy and matter flow among organisms and the environment (food chain and flow paragraph).
NGSS MS-LS2-4	Argue from evidence how ecosystem changes affect populations (extension ideas).
NGSS 5-LS2-1	Develop a model of matter moving among plants, animals, decomposers, and the environment (grade 5).
NGSS MS-ETS1	Engineering design, for the optional FabLab Upgrade (define the model, print, test against the real organism, revise).

Materials

- Student Packet (one per student), including the Research Organizer and Exhibit Checklist
- Internet access for research, plus at least one book source per team (schedule a library visit)
- Poster board or display materials, markers, printed images, art supplies
- FabLab Upgrade (optional): 3D printer and filament, a free CAD tool such as Tinkercad, paint for finished models

Facilitation Tips

- **Approve the choices.** Have each team submit its ecosystem and population for approval before researching. Two jaguar exhibits in one class is a wasted opportunity; the menu has range on purpose.
- **Organizer before poster.** Collect the Research Organizer before any display work begins. Every weak exhibit I have graded traced back to thin research, never to weak decorating.

- **Check limiting factors mid-project.** Students reliably list factors without explaining effects. A two minute conference per team ("how does that factor change your population's numbers?") fixes it while there is still time.
- **Present like zoo staff.** Teams present to the class as if the class were zoo visitors. Questions from the "visitors" count toward discussion and expose gaps kindly.
- **Start prints early.** If you run the FabLab Upgrade, queue the population prints during the research phase. Printers back up at exactly the moment every team wants one.

Grading at a Glance

Component	Points	Notes
Group Exhibit (poster rubric)	50	Neat, typed where possible, all required elements present.
Individual Participation	30	Work done on time, initiative, shared ideas, cooperative, dignified feedback.
Group Presentation	10	Ideas organized, information accurate.
Works Cited Page	10	Correctly cited (6), at least 1 internet source (2), at least 1 book source (2).
Total	100	Full rubrics are at the back of this packet.

Extension Ideas

- **The Invader Arrives:** introduce an invasive species into each team's ecosystem. Teams revise one panel of the exhibit to predict what changes, and defend the prediction with evidence (MS-LS2-4).
- **Drought Year:** announce a nonliving limiting factor event (drought, storm, freeze). Teams write a "one year later" update card for their exhibit.
- **Visitor Feedback:** run a gallery walk. Each student leaves one question and one compliment on a feedback card at each exhibit; teams answer the best question in writing.

Student Packet

ECOLOGY PROJECT: DESIGN A ZOO EXHIBIT FOR YOUR ECOSYSTEM

Name: _____ Team members: _____

Our ecosystem: _____ Our population: _____

Your Mission

You are co-directors for the Palm Beach Zoo. The National Zoo in Washington, D.C. has contacted the owners of your zoo: the Palm Beach Zoo has received a grant to build a new exhibit. The grant money will allow your zoo to build a spacious habitat with several species of the chosen population, and this exhibit will be the main attraction for your zoo.

The owners have asked you to build a display that will educate visitors on the ecosystem of this population, with detailed information on the habitat, community, niche, living and nonliving limiting factors, and adaptation features. You must also give an example of a predator-prey relationship, chart the producers and the consumers in the population's community, and describe how energy and mass flow through your ecosystem.

How to Begin

1. Select an ecosystem from the menu below.
2. Pick a population, either a plant or an animal.
3. Research the habitat, community, niche, limiting factors, and adaptation features. Complete the Research Organizer before you build anything.

The Ecosystem Menu

Ecosystem	Animals	Plants
Rainforest	Parrot, jaguar, monkey	Orchid (epiphytes), lianas (climbing vines)
Prairies	Pronghorn, coyote, grasshopper, buffalo	Eastern tall grass, wild rye, cord grass
Deserts	Tortoise, bobcat, Harris's antelope squirrel, various lizards, oryx	Various cacti, sage
Temperate Forest	Owls, elk, white-tailed deer	Mushrooms, dandelions
Arctic Tundra	Lynx, lemmings, musk ox, wolves, arctic fox, polar bear	Lichens, mosses
Mountains	Mountain lions, pikas,	Lichens

	mountain goat, hoary marmot	
Seashore or Wetland	Loggerhead turtle, dolphins, herons, pelicans, crabs	Seaweed

Research Organizer

Habitat. Describe the place where your population lives: the land or water, the climate, and what the population needs from it. (You will turn this into a paragraph on your exhibit, with a picture of the habitat.)

Community. Name the organisms that make up the community around your population: animals, plants, fungi, and others.

Niche. Explain the role of your population in the community. Example: the pine tree provides food and shelter to other organisms.

Limiting Factors. A limiting factor is anything that keeps a population from growing without limit. Find two of each kind, and explain how each one affects your population.

Factor	How it affects our population
Living factor 1:	
Living factor 2:	

Nonliving factor 1:	
Nonliving factor 2:	

Predator-prey relationship. Describe one predator-prey relationship in your ecosystem. Who eats whom, and what happens to each population if the other one grows or shrinks?

Adaptation Feature. Describe the adaptation feature of your population and how it helps the population survive. Example: the silversword plant that grows in Hawaii has tiny hair-like projections that protect the plant from extreme temperatures.

Food Chain Builder

Show a food chain of four organisms, beginning with a producer. Draw or write each organism, and draw arrows pointing in the direction the energy flows (from the organism being eaten to the organism that eats it).

Producer	Consumer	Consumer	Consumer

Producers and Consumers Chart. List the producers and consumers in your population's community.

Producers	Consumers

Energy and Matter Flow

Describe how energy and matter flow through your ecosystem. Keep in mind that energy is never created or destroyed. Highlight where "new" energy and matter come from in the ecosystem, and where the "lost" energy and matter go.

- Where does new energy enter? (Hint: it arrives the same way in almost every ecosystem on Earth.)
- What do producers do with that energy?
- At each step of the food chain, where does most of the energy go?
- What returns matter back to the soil and water so producers can use it again?

Exhibit Checklist

Check off each requirement as your team completes it. Every box must be checked before you present.

- ☐ **Ecosystem** used as the title of your exhibit display.
- ☐ **Population** shown as a drawing or a picture (or a 3D printed model, FabLab Upgrade).
- ☐ **Habitat:** a picture of the habitat and a paragraph describing the place where your population lives.
- ☐ **Community:** the organisms named, with a picture showing the community.
- ☐ **Niche:** the role of your population in the community, explained.
- ☐ **Food chain:** four organisms shown with pictures, beginning with a producer.
- ☐ **Two living limiting factors** shown in a drawing or picture.
- ☐ **Two nonliving limiting factors** shown with a picture, drawing, or writing.
- ☐ **Paragraph:** how the living limiting factors affect your population (include the predator-prey relationship).
- ☐ **Paragraph:** how a nonliving limiting factor affects your population.
- ☐ **Adaptation feature** of your population, described.
- ☐ **Energy and matter flow** described, including where new energy and matter come from and where lost energy and matter go.
- ☐ **Works cited page:** at least 1 internet source and 1 book source, correctly cited.

Research Resources

This list was checked and updated in November 2026. Every link below works.

- **Animal Diversity Web,** animaldiversity.org: species accounts with habitat, food habits, and ecosystem roles.
- **Windows to the Universe, Biomes and Ecosystems,** windows2universe.org/earth/ecosystems.html: a page for every major biome.
- **Ducksters, World Biomes and Ecosystems,** ducksters.com/science/ecosystems/world_biomes.php
- **Ducksters, Food Chain and Web,** ducksters.com/science/ecosystems/food_chain_and_web.php: producers, consumers, and nutrient cycles.
- **EEK! Environmental Education for Kids,** eekwi.org: animal and plant profiles for grades 4 to 8.
- **EPA Homework Resources,** epa.gov/students/homework-resources-about-environmental-issues: see the Ecosystems section.
- **Scholastic, Endangered Ecosystems,** teacher.scholastic.com/activities/explorer/ecosystems/
- **National Geographic Kids, Animals,** kids.nationalgeographic.com/animals: profiles, habitats, and adaptations.

Works Cited

Your works cited page is worth 10 points: correctly cited (6 points), at least 1 internet source (2 points), at least 1 book source (2 points). Use this format:

Website: Author (if given). "Page Title." Site Name. URL. Date you visited. Book: Author. Book Title. Publisher, year published.

The FabLab Upgrade: Print Your Population

The mission asks for a drawing or picture of your population. The FabLab Upgrade replaces the picture with something better: a model your visitors can walk around.

PRINT 1: The population itself.

Design and 3D print a model of your animal or plant for the center of your exhibit.

PRINT 2: The adaptation, enlarged.

Print your population's adaptation feature big enough for visitors to see and touch: a beak, a webbed foot, a shell, a cactus with its spines.

PRINT 3: Habitat pieces (early finishers).

Print terrain and habitat features and build a diorama of the habitat inside your exhibit.

The accuracy rule:

The model has to be accurate. The adaptation must be in the right place, at a scale your team can defend, and you must explain it in your presentation. If you cannot defend it, it does not go in the exhibit.

Our print plan:

Question	Our answer
What are we printing for Print 1?	
Which adaptation are we enlarging?	
What scale are we using, and how do we know it is defensible?	
Who is responsible for the CAD file?	
Print deadline (queue it early):	

Answer Key Notes (Teacher Only)

This is an open-ended design project, so there is no single answer key. Use these notes to judge accuracy quickly while teams research and present. One fully worked example is included, followed by the points to look for in any ecosystem.

Worked Example: Loggerhead Sea Turtle (Seashore or Wetland)

Element	What a strong answer includes
Habitat	Warm coastal ocean waters; females come ashore on sandy beaches to nest. Needs clean water, prey-rich feeding areas, and dark, undisturbed nesting beaches.
Community	Crabs, jellyfish, mollusks, seagrass, algae, fish, shorebirds, sharks, raccoons, and ghost crabs.
Niche	A predator of crabs, mollusks, and jellyfish that helps control those populations; its eggs and hatchlings are food for beach predators, and its nesting moves nutrients from ocean to beach.
Living limiting factors	Predators: raccoons and ghost crabs dig up nests; sharks hunt adults. Also acceptable: disease, or competition for nesting space.
Nonliving limiting factors	Storms and beach erosion destroy nests; sand temperature controls whether hatchlings are male or female; artificial light disorients hatchlings.
Predator-prey	Loggerhead and crab (turtle as predator), or shark and loggerhead (turtle as prey). Either direction is correct if the population effects are explained both ways.
Food chain	Phytoplankton (producer) to small shrimp or fish to loggerhead turtle to tiger shark. Seagrass-based chains are also acceptable.
Adaptation	Hard shell for protection; paddle-shaped flippers for swimming; strong jaws for crushing shells. Any one, explained well, earns the point.
Energy and matter flow	Sunlight enters through photosynthesis by phytoplankton and seagrass; energy transfers up the chain and is lost as heat at each step; decomposers return matter from dead

	organisms to the water and sand for producers to reuse.

What to Look For in Any Ecosystem

- **Habitat vs. niche:** the most common mix-up. Habitat is the address; niche is the job. If a team writes "its niche is the beach," send them back.
- **Limiting factors need effects:** a factor named with no effect on the population ("rainfall") is half an answer. Push for the mechanism: what happens to the population's numbers, and why.
- **Energy is lost as heat, not "used up":** accept "lost" language only when the destination (heat) is named. Energy is never destroyed; roughly 90 percent leaves as heat at each transfer, which is why food chains stay short.
- **New matter mostly does not enter:** matter cycles. New energy arrives constantly from the sun; matter is recycled by decomposers. Teams that claim new matter "comes from the sun" need a conference.
- **Food chain arrows:** arrows point toward the eater (the direction energy flows). Reversed arrows are the classic error.

Rubrics

Exhibit (Poster) Rubric, 50 points

Student name: _____

Category	4	3	2	1
Required Elements	The poster includes all required elements as well as additional information.	All required elements are included on the poster.	All but 1 of the required elements is included on the poster.	Several required elements were missing.
Labels	All items of importance are clearly labeled, readable from at least 3 ft. away.	Almost all items of importance are clearly labeled, readable from at least 3 ft. away.	Many items of importance are clearly labeled, readable from at least 3 ft. away.	Labels are too small to view OR no important items were labeled.
Graphics: Relevance	All graphics relate to the topic and make it easier to understand. All borrowed graphics have a source citation.	All graphics relate to the topic and most make it easier to understand. Some borrowed graphics have a source citation.	All graphics relate to the topic. One or two borrowed graphics have a source citation.	Graphics do not relate to the topic OR several borrowed graphics do not have a source citation.
Attractiveness	Exceptionally attractive in design, layout, and neatness.	Attractive in design, layout, and neatness.	Acceptably attractive, though it may be a bit messy.	Distractingly messy or very poorly designed. Not attractive.
Grammar	No grammatical or mechanical mistakes.	1-2 grammatical or mechanical mistakes.	3-4 grammatical or mechanical mistakes.	More than 4 grammatical or mechanical mistakes.

Individual Participation Rubric, 30 points

Criteria	4	3	2	1
Comes to class prepared with all				

materials				
Works well individually or with a partner				
Stays focused throughout the task (discussions are on topic only)				
Shows progress on the assignment (can show work accomplished during the time given)				

Also weigh: work done on time, showed initiative, shared ideas, cooperative, gave feedback that was dignified.

Presentation Rubric, 10 points

Category	1	2	3	4
Organization	Audience cannot understand the presentation because there is no sequence of information.	Audience has difficulty following because the student jumps around.	Information is presented in a logical sequence the audience can follow.	Information is presented in a logical, interesting sequence the audience can follow.
Subject Knowledge	Student does not have a grasp of the information and cannot answer questions.	Student is uncomfortable with the information and answers only rudimentary questions.	Student is at ease with expected answers but fails to elaborate.	Student demonstrates full knowledge, answering questions with explanations and elaboration.
Graphics	Student uses superfluous graphics or no graphics.	Student occasionally uses graphics that rarely support the text and	Student's graphics relate to the text and presentation.	Student's graphics explain and reinforce the text and presentation.

		presentation.		
Mechanics	Four or more spelling and/or grammatical errors.	Three misspellings and/or grammatical errors.	No more than two misspellings and/or grammatical errors.	No misspellings or grammatical errors.
Eye Contact	Student reads all of the report with no eye contact.	Student occasionally uses eye contact but still reads most of the report.	Student maintains eye contact most of the time but frequently returns to notes.	Student maintains eye contact with the audience, seldom returning to notes.
Elocution	Student mumbles, mispronounces terms, and speaks too quietly for the back of the class to hear.	Student's voice is low; terms are mispronounced; audience has difficulty hearing.	Student's voice is clear; most words pronounced correctly; most of the audience can hear.	Clear voice and correct, precise pronunciation so all audience members can hear.