

Hopeful Habitats

Engineering Design Challenge Project Plan

DESIGN CHALLENGE: *Students will “engineer” a zoo-like exhibit designed with animal habitat needs in mind; they will identify key components of habitats (food, water, shelter, space, and air) that different endangered animals need and explore the connections and interactions. They will design their zoo exhibits to educate people by illustrating what is important in the habitats and how the habitat is changing. Students will have a budget they must keep to in order to begin to understand what constraints are and how they impact design decisions.*

Systems thinking focus will underlie this project, along with a focus on stewardship of the planet and care for other creatures. In place of functional testing, each group will get feedback on their preliminary designs from other groups and they will use that to make modifications for their final design.

Optional: Challenge teams to design and include a “toy” or “enrichment” device for their animal. See Stanford video.

OVERALL FLOW

CLASS	
1 -2	Hook: Reading about animals and their habitats (See Project Overview and Resources). Following up with Discussion Video: Habitats (non-cartoon) https://www.pbs.org/video/habitat-habitat-basics-buxg6x/ Cartoon video about Habitats https://youtu.be/Xj1ASC-TlsI New Video about Protecting Species https://next-media-api.ft.com/renditions/15766616241460/1280x720.mp4
3	Quick Build: The Missing Piece <i>Hands-on investigation of how different parts of a habitat depend on other parts; students will work in teams to create the tallest possible “habitat” from a specific collection of materials – including tape. They will then be given an identical collection without tape with the challenge of creating the same “habitat”.</i>

	<i>Learning Goal- identify what goes wrong when one thing (tape) is missing; highlights impact of resource constraints.</i> The Missing Piece Teacher Instructions
4 - 6	Background Instruction/Research: • Types of habitat • Who lives where (<i>Possible matching game/activity using the photos from Donkey Sanctuary)</i> • My habitat – what I need every day; complete I Live in a Habitat worksheet (individual) • What does it mean to be endangered? • Creating awareness – what can zoos do? • Engineering an exhibit Note: Groups can be formed in this phase. Explain jobs to students and have them fill in the Hopeful Habitat Jobs form.
7	Assigning Animals/Beginning to plan – • Groups choose (randomly; from hat/bowl) an animal. <i>Endangered species include Bengal tiger, panda, rhinoceros, gray parrot, snow leopard, African penguins, mountain gorillas (https://animalfactguide.com/animal-facts/); World Wildlife Federation species list</i> • Designing a habitat - What does our animal need in a habitat? Planning Our Animal's Habitat worksheet • Deciding on a habitat – Constraints and Criteria worksheet • How much can we spend? Discuss the idea that money is a constraint (limitation). Note: <i>Estimated Budget will be 30 BB\$.</i>
8	Brainstorming- • What should our exhibit look like (how can we engage viewer) • What should our “zoo” look like – layout and theme Note: <i>Use Post-Its to come up with ideas; encourage “crazy” but help groups come back to their plan and constraints and criteria before creating final layout. Have groups sort ideas into 3 groups:</i> <i>Ideas that will work</i> <i>Ideas that might work</i> <i>Ideas that we need to rule out</i>
9	Planning • Creating a layout (Large scale graph paper is helpful). Explain that exhibit layouts will be put together to form layout for the “zoo” of information about endangered species. • Deciding on materials- Keep track of Materials on the Habitat Materials List <i>Optional: Groups can create 1-3 common areas for the zoo (Snack Bar, Information Booth, Gift Shop, etc.)</i>
10 -13	Building – Focus on trying to follow the plan; create an information sheet about how we can help this species (See Template; can be made larger if desired). <i>Note: If included in project, create “enrichment” device.</i>

15	Feedback – Survey other groups about your exhibit and decide what to modify. Groups should give each visitor an Exhibit Feedback Form
16	Modification and “housekeeping” – each group can make up to 2 changes and class makes sure "zoo" is ready for viewing
17	Share Your New "Zoo" of information!

Possible Student Reflection/Assessment Forms:

[Am I a Good Team Member?](#)

[Rubric How Well Do I Engineer?](#)

HOPEFUL HABITATS!

Engineering Design Challenge

The Bengal Tiger is in trouble! He and many other animals are “endangered” and there are not many of them left. Their homes or



“habitats” are being destroyed. Saving them is a big challenge but it begins by learning about their habitats and by making lots of people aware of the problems they face. Can you “engineer” a zoo that will help other people learn about these animals and their habitats? You will need to think about what needs to be in the habitat, how much it will cost to build it, and how you can help people to learn about your animal.

Engineers are helpers. They use what they have learned in school to make things better for people (and animals). Engineers build all sorts of things like buildings, computers, shoes, cars, medicines, and even zoos!

Engineers work together in teams and they always do the following:

1. **LEARN** about the problem.

- What is a habitat?
- What kind of animals live in different habitats?
- What is happening to their habitats?
- What are some of the things you need to think about for a zoo exhibit?

2. **PLAN** what they will do

- How can you build a zoo that will help people to learn about animals and their habitats?

- What materials will you use?
- How much will your exhibit cost?
- Can you draw a picture of the plans for the zoo

3. **BUILD** a model

- Models help us to think about what might help.
- They help us to explain our ideas.

4. **TEST** their models

- Testing help us to see if our idea works. Sometimes we have people look at what we have built to let us know if they like it and if they have learned anything from it.
- Models also help us to think about what would make our zoo better for the animals and help people to learn more.

5. **SHARE** your ideas!

- Invite people to come to your “zoo” and tell them about what would help these endangered species and why it is important to do that.

Teachers Instructions/Student Worksheet

Time: 30 minutes

Group Size: 3 students

Goals: To highlight that every part of habitat makes a difference; systems thinking exploration of dependency and connections

Materials (per group):

Part 1

4 pieces of newspaper

12 pipe-cleaners or straws

Scotch Tape (one roll per group with a tiger sticker on it)

Part 2

4 pieces of newspaper

12 pipe-cleaners or straws

Tools: Scissors (if desired)

1. **Introduction:** Point out that a home or habitat depends on the resources available.
2. **Materials Distribution (Part 1):** Create a collection of materials for each group. Do not give groups their materials until they have shown you a sketch of a possible building.
3. **Planning:** Encourage groups to make a sketch of how they think they will be able to make the tallest building possible in 15 minutes. Have groups show you their sketches before allowing them to build.
4. **Give groups approximately 15 minutes to build their structure.** It may be helpful to give each group a piece of felt (9in. X 12 in.) to build on. Make sure that the groups understand that they should not tape their building to the felt or anything else (i.e., building should be free-standing).
5. Take some time to praise/discuss each building.

6. **Environmental Change: For Part 2, tape is not an option!** Compare its' loss to extinction of a species or to deforestation.
7. **Challenge the groups to try to build the same structure** (as a default, they can build a different one) without using any tape.
8. **Allow about 10-15 minutes.**
9. **Have groups share** their experiences. Point out that they can think of the missing tape as something missing in the habitat. It can be an animal, a plant, water, etc. One missing piece can make the whole system fall apart. A missing piece can also create changes called adaptations.
10. Take time to allow groups to discuss and share how they tried to "adapt".

I LIVE IN A HABITAT

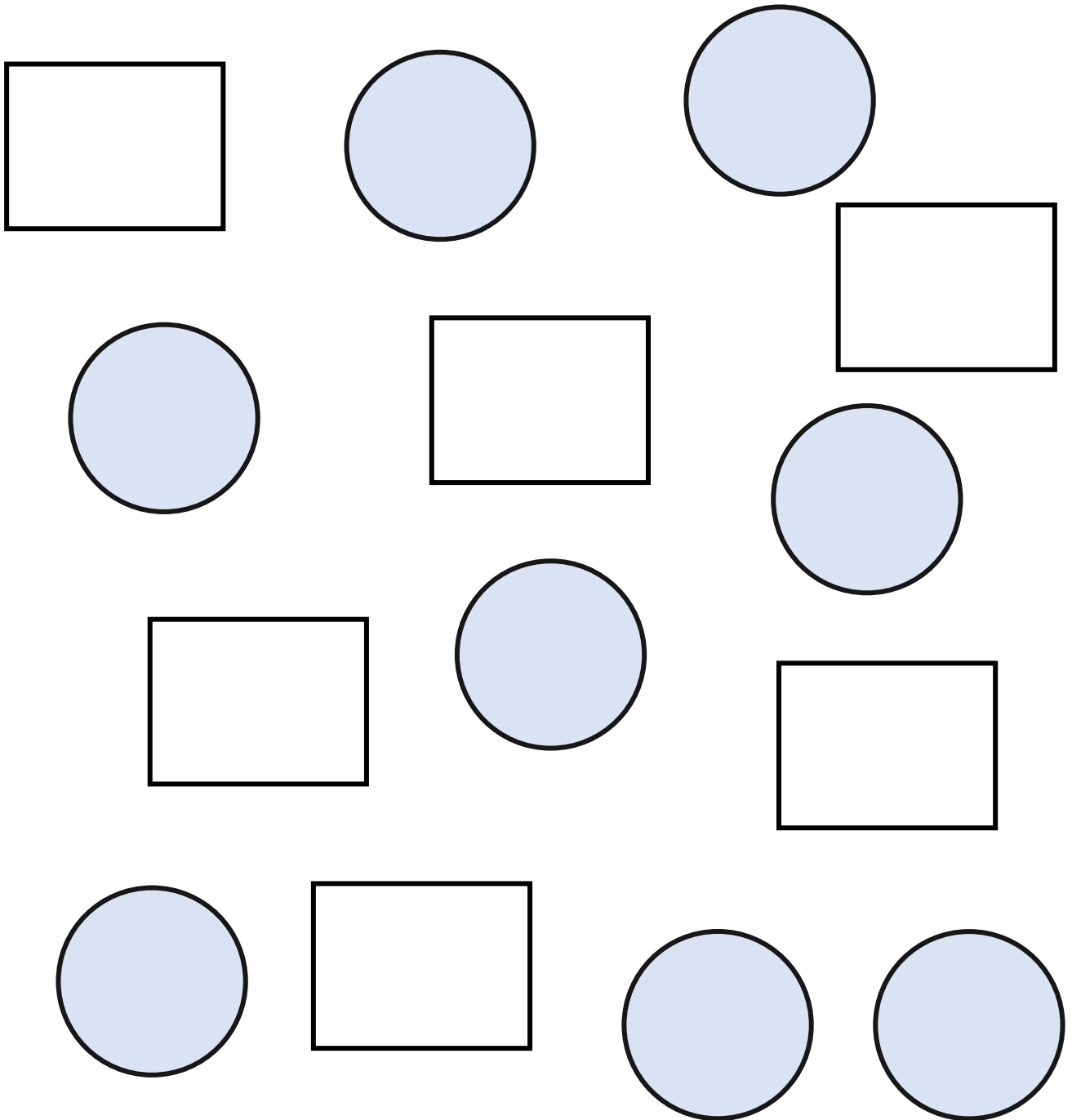
Like all living creatures, you live in a habitat. Your habitat is defined by the things you do every day and the people and things that help you. Many of the things in your habitat are like those in the habitats of other animals. For instance, we need to eat and sleep like they do. But we also have some things that make our habitats unique and, sometimes, a little complicated. For instance, we go to school and animals do not. So we need a way to get to school and teachers when we get there.

Complete the table below by listing some of things you do in one day and some of the people or things that help you do it.

Activities I Do	Things or People that Help Me

Connecting the Things and People I Need in My Habitat

Habitats are made of many connected things. **Put the things you do (activities) in the boxes** and **the people and things in your habitat in the circles**. Use arrows and lines to shows how things are connected. Think of lots of connections.



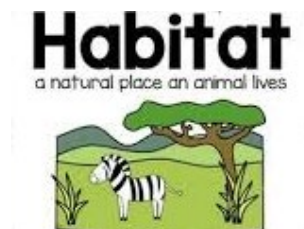
HOPEFUL HABITATS

JOBS

Teams work best when everyone has a slightly different job, especially when there is a lot to learn and a lot to do. This way everyone has something to do every day. It makes it easier to do a really good job on any big project!

Read about each job and fill in the form once you know who will do each job.

Animal Expert – knows all about the animal. This person knows what the animal likes to eat and what it likes to do all day and night. <i>Special Jobs I Have:</i>	Name:
Habitat Engineer – knows all about where the animal lives. Helps to decide what type of shelter the animal needs and what needs to be in the habitat. <i>Special Jobs I Have:</i>	Name:
Materials Manager – keeps track of what materials are used to build the habitat. Fills in Materials List. Makes sure team does not spend more than they are supposed to. <i>Special Jobs I Have:</i>	Name:



PLANNING OUR ANIMAL'S HABITAT

Group _____

Our Animal _____

What type of habitat does your animal need? Circle one.

Jungle

Desert

Forest

Polar

Beach

Sea

River

Savannah

Will it be a large habitat or a small one? _____

What shape should it have? Draw a sketch here.



Animals need certain things in their habitats. Write some things you need for each category.

FOOD

PLANTS

SHELTER

SPECIAL SPACES/THINGS

CONSTRAINTS AND CRITERIA

Hopeful Habitats

In order to come up with a good design, engineers think about what would make a good solution – these are called **“criteria”**. Criteria are usually based on the needs and wants of those impacted by a solution. Engineers also think about **“constraints”**. These are the things that limit what they can do to create a solution. Things like money, time, and available materials are constraints that engineers almost always think about.

You can develop some criteria by thinking about some of the needs and wants that your exhibit should meet. Needs are the things that you must have. Wants are the things that you would like to have. Together they make up some of the criteria for a good solution. In other words, if your solution can do or supply these things, it should be a good solution. These may be things that are important to the animals, the zookeeper, and the people who visit your zoo. Your teacher will help you think about some of these needs and wants as you fill in the table on the next page.

WHO	NEEDS (must have)	WANTS (like to have)
Animals		
Zookeepers		
Visitors		

You can't do everything in one solution, so work with your group to decide on the 3 things most important for the animals and the 1 or 2 things most important for the zookeepers and visitors. Circle all of these.

TEACHER Information

Some things to consider

What animals need and want in a habitat	What zookeepers want in a habitat	What zoo visitors want in a habitat
NEEDS Food/water Sleeping place Temperature range for life Animal-specific needs (lives in water, hangs from ceiling, etc) Safe from predators WANTS Just the right size Just right temperature Friends / a mate Features (water, trees, etc?) Exercise/not boring Noise is low Nothing scary	NEEDS Keeps animals safe (from each other, other animals, visitors, diseases) Keep animals from escaping WANTS Easy to get the animals in and out Easy to feed the animals Easy to clean the habitat	NEEDS Keeps visitors safe from animals WANTS See the animals Animals look happy / are active Looks nice/natural

HABITAT MATERIALS LIST

Material	Pieces	Cost for each piece In Building Bucks (BB\$)	Total Cost
Cardboard		2	
Foam Board		4	
Foam		2	
Straws		1	
Aluminum Foil		2	
Pipe Cleaners		1	
Popsicle Sticks		1	
Clips		0.50	
Pom Poms		0.50	
Specials			
		Total Cost of Exhibit	<u> </u> BB\$

You do not need to pay for the following things but you can only have a certain amount. Please write down how much you use.

Material	Allowed	How Much We used
Scotch Tape	1 roll	
Duct Tape	24 inches	
Clay	1 can	

Your teacher will also give you scissors and glue if you need them.

Can you think of anything else that you will need? Write it in the space below.

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ALL ABOUT _____

Where I live:

What is happening to my real habitat:

What I eat:

How many of us are left? Why are we endangered?

Exhibit Feedback Form

Team Members
Animal Expert:
Habitat Engineer:
Materials Manager:
Our Animal:
Feedback Form Questions: • Please circle an answer for each question. 5 is the best score. 1 means “not at all” or “nothing” • Comments are welcome!
Question 1: Do you like the way our exhibit looks? 1 2 3 4 5
Question 2: If we made a real exhibit using this model, do think our animal would like it? 1 2 3 4 5
Question 3: Did you learn anything about our animal? 1 2 3 4 5
Please tell us one thing that you learned from our exhibit.
Comments (Tell us about anything that was really good or not so good. It will help us to make our exhibit better!)

HOW WELL DO I ENGINEER?

NAME: _____

I can explain why we are doing the project.

1. still learning



2. sometimes



3. almost always



I can think of ideas for what to make or do in the project.

1. still learning



2. sometimes



3. almost always



I can help pick the best idea.

1. still learning



2. sometimes



3. almost always



I can help improve our idea.

1. still learning



2. sometimes



3. almost always



I can help make something unique and useful.

1. still learning



2. sometimes



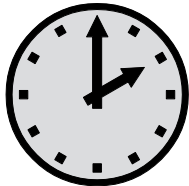
3. almost always



AM I A GOOD TEAM MEMBER?

NAME:

I DO MY WORK FOR THE TEAM ON TIME



1. still learning



2. sometimes



3. almost always



I HELP MY TEAMMATES



1. still learning



2. sometimes



3. almost always



I LISTEN TO THE IDEAS OF MY PARTNERS



1. still learning



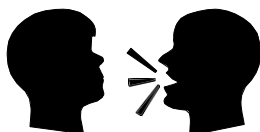
2. sometimes



3. almost always



I SHARE MY IDEAS WITH MY TEAM



1. still learning



2. sometimes



3. almost always



I TREAT MY TEAMMATES WITH RESPECT



1. still learning



2. sometimes



3. almost always

