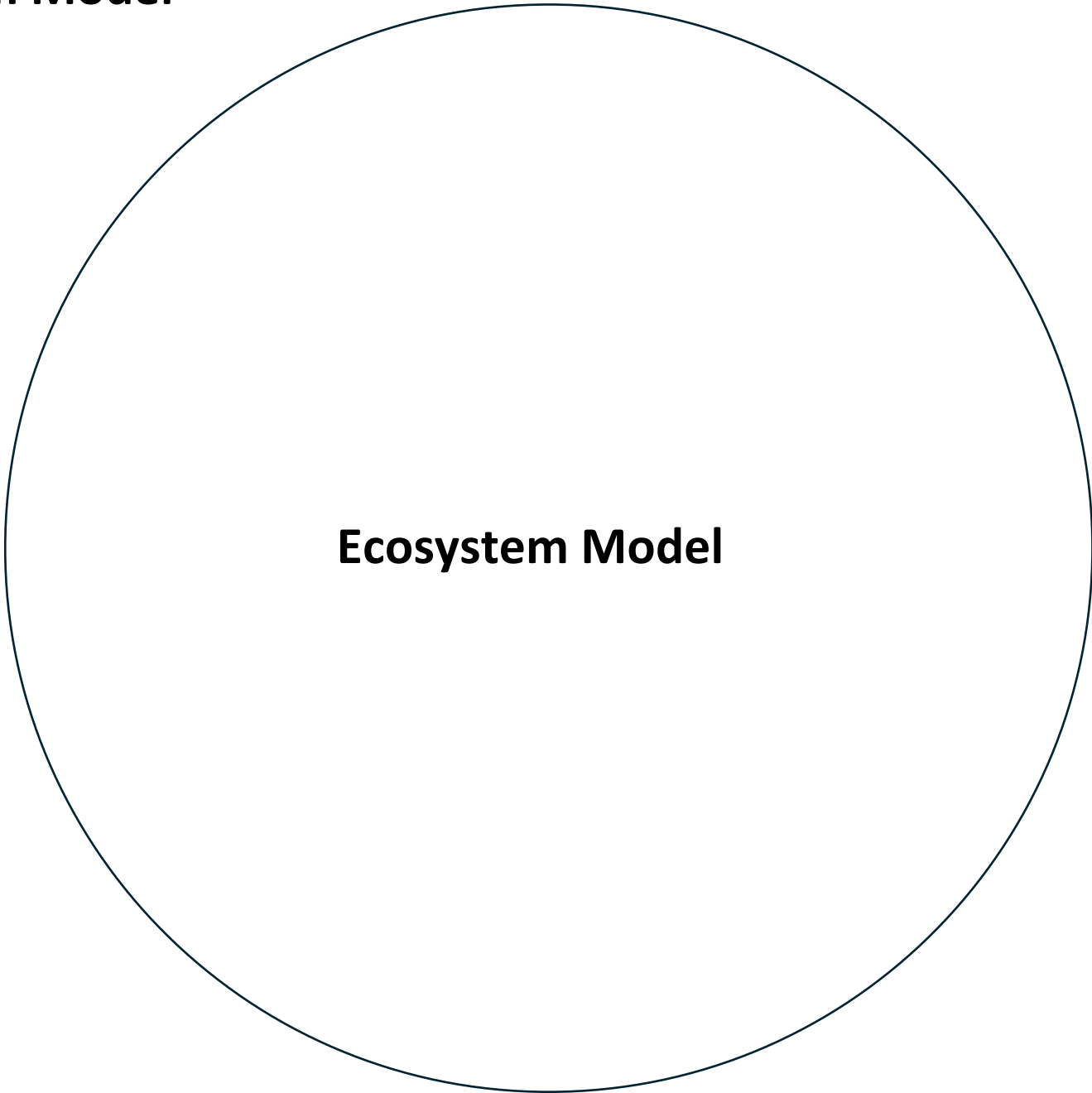


Ecosystem Resilience! Printable Pages

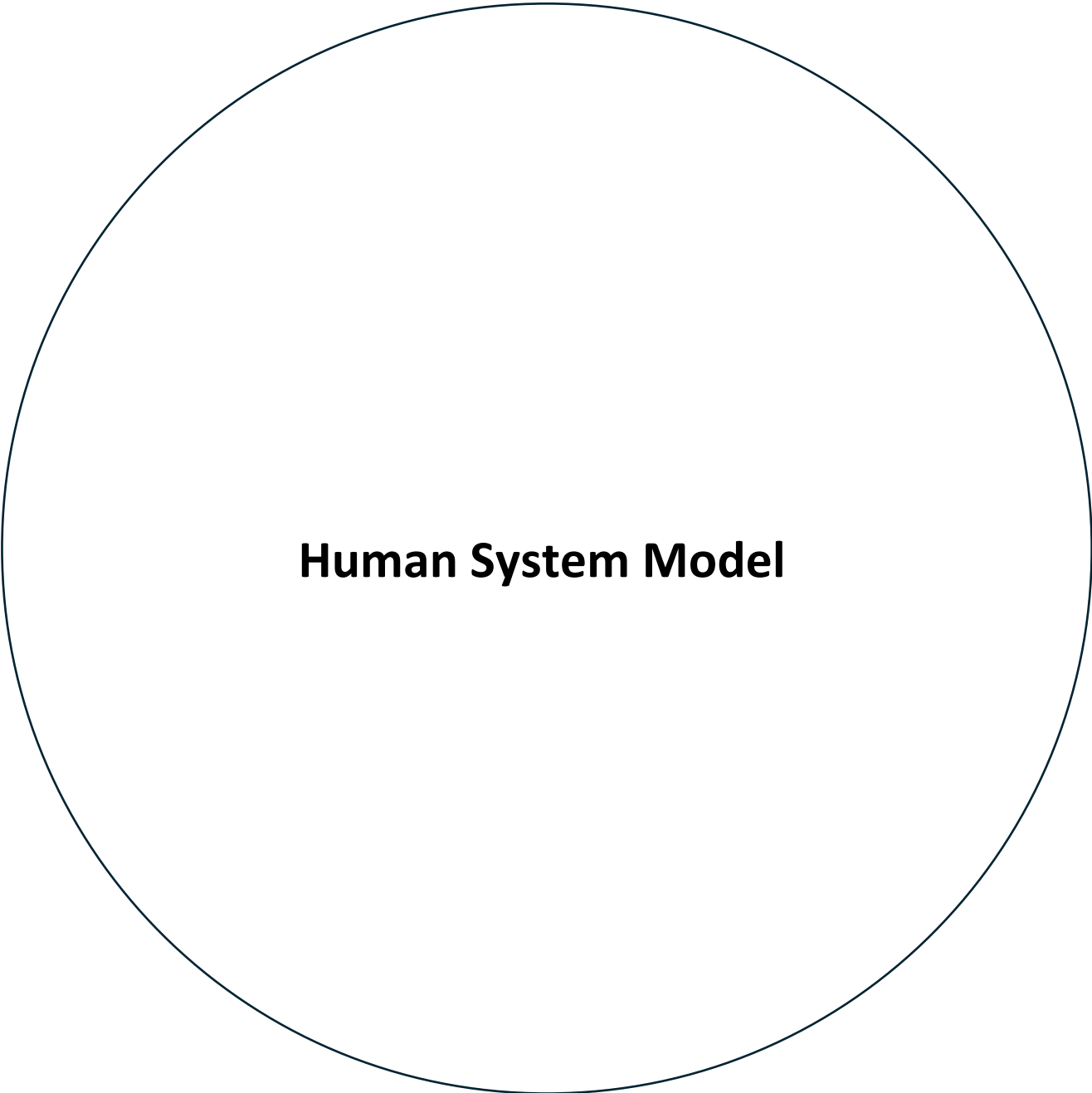
- Ecosystem Model
- Human System Model
- Ecosystem Investigation
- Human System Investigation
- Diversity Match Card
- Natural Disturbance Cards
- Species Cards
- Human Challenge Cards
- Savanna Natural Disturbance Cards
- Savanna Species Cards
- Savanna Human Challenge Cards
- How to Adapt
- Innovator Cards
- Prototype Plan
- Resilience Assessment Chart
- Redesign Plan

Ecosystem Model



Ecosystem Model

Human System Model



Human System Model

Ecosystem Investigation

Organisms	Relationships

Human System Investigation

People	Relationships

Diversity Match Card

Someone who knows multiple languages	Someone who is used to being part of a team	Someone who knows five places in your area to get food	Someone who likes to help others	Someone who has a close relationship with someone over 50 years old
Someone who likes to organize	Someone who knows what to do if a person is cut or scraped	Someone who feels connected to the natural world	Someone who knows someone from a different country	Someone who has experienced an unfair situation
Someone who has experienced a natural disaster	Someone who is a good storyteller	Someone who is good at considering different perspectives	Someone who is used to being a leader	Someone who has lived in your area for more than 10 years
Someone who likes to create art	Someone who has cared for a younger child	Someone who knows how to conserve or save water	Someone who has grown something that can be eaten	Someone who is comfortable speaking to people
Someone who has experienced a major change	Someone who can name five different plants in your area	Someone who knows a local area leader	Someone who is good at working independently	Someone who knows how to spend the night outdoors

Natural Disturbance Cards

Prairie dog communities disrupt the soil and vegetation, creating new habitats and increasing biodiversity. <u>Action:</u> Remove and replace duplicate plant species with non-duplicates.	Bison migration creates wet areas through wallows and leaves behind dung, enriching the soil. <u>Action:</u> Remove and replace duplicate plant species with non-duplicates.	Dung beetles process the dung of bison and other animals and cycle nutrients back to enrich the soil. <u>Action:</u> Add a new Soil card to your ecosystem.	Wolf packs control herbivore populations, especially by eating old or ill herbivores. <u>Action:</u> Remove and replace duplicate herbivore species with non-duplicates.
Fire burns through old vegetation, allowing new, more nutritious plants to flourish. <u>Action:</u> Remove and replace duplicate plant species with non-duplicates.	Drought, when it is occasional, encourages plants with deep roots, discouraging erosion. <u>Action:</u> Remove and replace duplicate plant species with non-duplicates.	Disease can spread through a population, limiting its size and removing the weak organisms. <u>Action:</u> Remove and replace all duplicate species with non-duplicates of the same type, such as herbivores.	Grasshopper swarms eat old vegetation. Their dung enriches the soil and they are a food source for many animals. <u>Action:</u> Remove and replace duplicate plant species with non-duplicates. If possible, add a new herbivore.

Species Cards

1 SOIL Soil allows plants to grow.	1 SOIL Soil allows plants to grow.	1 SOIL Soil allows plants to grow.	1 SOIL Soil allows plants to grow.	1 SOIL Soil allows plants to grow.
2 PLANT <u>Big Bluestem</u> Needs: Soil	2 PLANT <u>Coneflower</u> Needs: Soil	2 PLANT <u>Yarrow</u> Needs: Soil	2 PLANT <u>Dropseed</u> Needs: Soil	2 PLANT <u>Switchgrass</u> Needs: Soil
2 PLANT <u>Little Bluestem</u> Needs: Soil	2 PLANT <u>Blue Grama</u> Needs: Soil	2 PLANT <u>Serviceberry</u> Needs: Soil	3 HERBIVORE <u>Prairie Dog</u> Needs: Plant	3 HERBIVORE <u>Bison</u> Needs: Plant
3 HERBIVORE <u>Mule Deer</u> Needs: Plant	3 HERBIVORE <u>White-Tailed Jackrabbit</u> Needs: Plant	3 HERBIVORE <u>Monarch Butterfly</u> Needs: Plant	3 HERBIVORE <u>Big-Headed Grasshopper</u> Needs: Plant	3 HERBIVORE <u>Prairie Vole</u> Needs: Plant
4 CARNIVORE <u>Western Meadowlark</u> Needs: Grasshopper or Butterfly	4 CARNIVORE <u>Black-Footed Ferret</u> Needs: Prairie Dog	4 CARNIVORE <u>Gray Wolf</u> Needs: Bison, Deer, or Jackrabbit	4 CARNIVORE <u>Burrowing Owl</u> Needs: Vole or Snake	4 CARNIVORE <u>Plains Garter snake</u> Needs: Vole or Meadowlark
DECOMPOSER <u>Dung Beetle</u> Needs: Plant, Herbivore, or Carnivore Creates: Soil	DECOMPOSER <u>Soil Fungi</u> Needs: Plant, Herbivore, or Carnivore Creates: Soil	DECOMPOSER <u>Earthworm</u> Needs: Plant, Herbivore, or Carnivore Creates: Soil	DECOMPOSER <u>Beetle</u> Needs: Plant, Herbivore, or Carnivore Creates: Soil	DECOMPOSER <u>Soil Bacteria</u> Needs: Plant, Herbivore, or Carnivore Creates: Soil

Human Challenge Cards

Cropland creation takes grasslands and changes them into areas to grow crops, such as wheat or corn.	Fencing land for cattle grazing means other species can no longer migrate.	Pest control by spraying insecticides can remove both species thought of as pests and other insects.	Animal elimination removes certain species, often because they either eat cattle or crops.	Introduced species change the ecosystem by bringing in species that have no natural predators.
<u>Action:</u> Remove one Soil card and anything built on it.	<u>Action:</u> Remove one Bison card and anything built on it.	<u>Action:</u> Remove all Butterfly and Grasshopper cards and anything built on them.	<u>Action:</u> Remove all Wolf and Prairie Dog cards and anything built on them.	<u>Action:</u> Remove one Plant species and anything built on it.

Savanna Species Cards

1 SOIL Soil allows plants to grow.	1 SOIL Soil allows plants to grow.	1 SOIL Soil allows plants to grow.	1 SOIL Soil allows plants to grow.	1 SOIL Soil allows plants to grow.
2 PLANT <u>Elephant grass</u> Needs: Soil	2 PLANT <u>Buffalo Thorn</u> Needs: Soil	2 PLANT <u>Heath Aster</u> Needs: Soil	2 PLANT <u>Baobab</u> Needs: Soil	2 PLANT <u>Star Grass</u> Needs: Soil
2 PLANT <u>Rhodes Grass</u> Needs: Soil	2 PLANT <u>Red Oat Grass</u> Needs: Soil	2 PLANT <u>Acacia</u> Needs: Soil	3 HERBIVORE <u>Meerkat</u> Needs: Plant	3 HERBIVORE <u>Wildebess</u> Needs: Plant
3 HERBIVORE <u>Impala</u> Needs: Plant	3 HERBIVORE <u>Hare</u> Needs: Plant	3 HERBIVORE <u>Common Bush Brown Butterfly</u> Needs: Plant	3 HERBIVORE <u>Termite</u> Needs: Plant	3 HERBIVORE <u>African Grass Rat</u> Needs: Plant
4 CARNIVORE <u>Cape Weaver Bird</u> Needs: Termite or Butterfly	4 CARNIVORE <u>Banded Mongoose</u> Needs: Rat, Bird, or Snake	4 CARNIVORE <u>Spotted Hyena</u> Needs: Wildebeest, Impala, or Bird	4 CARNIVORE <u>African Grass Owl</u> Needs: Rat or Dung Beetle	4 CARNIVORE <u>Black Mamba Snake</u> Needs: Rat or Bird
DECOMPOSER <u>Dung Beetle</u> Needs: Plant, Herbivore, or Carnivore Creates: Soil	DECOMPOSER <u>Soil Fungi</u> Needs: Plant, Herbivore, or Carnivore Creates: Soil	DECOMPOSER <u>Earthworm</u> Needs: Plant, Herbivore, or Carnivore Creates: Soil	DECOMPOSER <u>Beetle</u> Needs: Plant, Herbivore, or Carnivore Creates: Soil	DECOMPOSER <u>Soil Bacteria</u> Needs: Plant, Herbivore, or Carnivore Creates: Soil

Savanna Natural Disturbance Cards

Meerkat Communities communities disrupt the soil and vegetation, creating new habitats and increasing biodiversity. <u>Action:</u> Remove and replace duplicate plant species with non-duplicates.	Wildebeest Migration creates wet areas through wallows and leave behind dung, enriching the soil. <u>Action:</u> Remove and replace duplicate plant species with non-duplicates.	Dung beetles process the dung of bison and other animals and cycle nutrients back to enrich the soil. <u>Action:</u> Add a new soil card to your ecosystem.	Banded Hyena packs control herbivore populations, especially by eating old or ill herbivores. <u>Action:</u> Remove and replace duplicate herbivore species with non-duplicates.
Fire burns through old vegetation, allowing new, more nutritious plants to flourish. <u>Action:</u> Remove and replace duplicate plant species with non-duplicates.	Drought occasional drought encourages plants with deep roots, discouraging erosion. <u>Action:</u> Remove and replace duplicate plant species with non-duplicates.	Disease can spread through a population limiting its size and removing the weak organisms. <u>Action:</u> Remove and replace all duplicate species with non-duplicates of the same type, such as herbivore.	Termite colonies eat old vegetation creating mounds. They enrich the soil and help water move through the soil. <u>Action:</u> Remove and replace duplicate plant species with non-duplicates.

Savanna Human Challenge Cards

Cropland creation takes grasslands and changes them into areas to grow crops such as wheat or corn. <u>Action:</u> Remove one soil card and anything built on it.	Fencing land for cattle grazing means other species can no longer migrate. <u>Action:</u> Remove one wildebeest card and anything built on it.	Pest control by spraying insecticides can remove both species thought of as pests and other insects. <u>Action:</u> Remove butterfly and termite cards and anything built on them.	Animal elimination Removes certain species, often because they either eat cattle or crops. <u>Action:</u> Remove hyena or meerkat cards and anything built on them.	Introduced species change the ecosystem by bringing in species that have no natural predators. <u>Action:</u> Remove one plant species and anything built on it.
--	---	---	--	---

How to Adapt

Change	Adaptation

Innovator Cards (page 1)



Gerenuks in East African deserts use their long necks and limbs to stand on their hind legs and reach food on high branches during dry periods.



Desert locusts in Central Africa and the Middle East form large swarms to travel great distances, consuming almost any type of sparse vegetation they find.



Tree tumbo plants in southern African deserts capture coastal fog moisture with their long leaves and channel it toward their root base to survive.



Sand grouse in African and Asian deserts absorb water into their belly feathers, then fly long distances to bring the water back to their chicks.



Baobab trees in African and Australian deserts can store up to 120,000 liters of water in their trunks to endure long droughts.



Thorny devil lizards in Australian deserts collect water from any part of their body with specialized grooves in their skin, channeling it to their mouth.

Innovator Cards (page 2)



Aloe vera in North African and Arabian Peninsula deserts store water in their thick, succulent leaves and are coated with a waxy substance that reflects sunlight to keep them cool.



Termites in global deserts build mounds with clay and sand walls and natural ventilation systems inside to regulate temperature and manage heat.



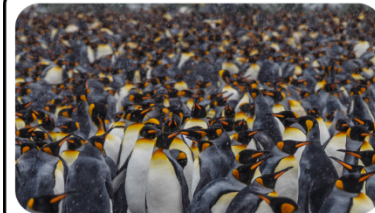
Hair grass in Antarctic deserts perform photosynthesis at low temperatures and use deep roots to absorb nutrients from thin soil.



Desert lilies in the Southwest U.S. deserts remain dormant underground until there is enough moisture to flower.



Barrel cacti in North American deserts store large amounts of water in their thick stems to dissolve nutrients and survive dry periods.



Emperor penguins in Antarctic cold deserts huddle together to conserve heat and have waterproof feathers for insulation.

Prototype Plan

Prototype Plan	
Problem	
Design Phase Notes	
Create Phase Notes	
Iterate Phase Notes	

Resilience Assessment Chart

Resilience trait	Doing well	Could be better	Human score	Ecosystem score
Diversity				
Connectivity				
Adaptation				
Innovation				

Redesign Plan

Redesign Plan	
Design sketch	Design goals