1.7

Food Web Resiliency

Grade Level

6-9

Subjects

Science

Time Frame

1-2 class periods

Teacher Materials

- Oak Woodlands Ecosystem Species Cards
- Sample Ecosystem 1 and 2
- Scenario Notetaker
- Scenario Notetaker- Teacher Guide
- Resiliency Rubric

In this lesson, students apply their knowledge of **biodiversity** and Oak Woodland species to a model of their own making. Students will design a **resilient ecosystem** and then test their ecosystem against a series of scenarios. This lesson prepares students to explore Traditional Ecological Knowledge in the preceding lesson.

Teacher Background

The resiliency of ecosystems and food webs depends on the **biodiversity**, **adaptability,** and **ability** for the ecosystem to sustain itself through connections for energy transfer. Since settlers seized control of California, development has impacted the resiliency of California's Oak Woodlands and weakened its food webs. Mass deforestation, pollution of the air and waterways, development of cities and towns, fire suppression, and overall poor land management have challenged the ecosystem and destroyed many food webs that Native peoples and other species rely on.

Through this activity, students begin to see that organisms within an ecosystem do not exist in isolation from one another, and that the variety of interactions that they have with one another contributes to the strength of the food web.

Organisms that are able to make their own energy through **photosynthesis** are called **autotrophs,** while organisms that receive nutrition through consuming other organisms are called **heterotrophs,** or consumers. Both are important to the food web.

This material was created in partnership between the California Indian Museum and Cultural Center and Redbud Resource Group.

In addition, the relationship between **predator** and **prey** among animals will become clear through the modeling process. Many consumers are also predators, meaning they consume other animals, hunting or catching them. The prey, hoping to avoid being eaten by the predator, attempts to flee, hide, or disguise itself. When the prey animal is unsuccessful, it becomes food and energy for the consumer. Many animals are both predator and prey, depending on the situation. Apex predators, on the other hand, are at the top of the food chain and do not typically serve as prey for any organism.

Because all living organisms die, all organisms rely on **decomposers** to recycle nutrients back into the ecosystem. Decomposers, represented by mushrooms in this lesson, break down carcasses and waste so that their nutrients can be returned to the ecosystem.

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1.7 Food Web Resiiency Pt.1

Healthy Ecosystems Feed Healthy Communities

Vocabulary

- **Keystone Species:** A species on which other species in an ecosystem largely depend, such that if it were removed the ecosystem would change drastically.
- **Ecosystem:** A biological community of interacting organisms and their physical environment.
- **Consumer:** An organism that derives the organic compounds and energy it needs from the consumption of other organisms; a heterotroph.
- **Apex Predator:** A predator at the top of a food chain that is not preyed upon by any other animal
- **Predator:** An organism that hunts, catches, kills, and eats other animals
- **Prey:** An organism that is caught, killed and eaten by a predator
- **Trophic Level:** One of the hierarchical strata of a food web characterized by organisms which are the same number of steps removed from the primary producers
- **Primary Producer:** Organisms that convert energy from light or heat into energy and organic tissue. Plants are an example of a primary producer.

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1.7 Food Web Resiiency Pt.1

Healthy Ecosystems Feed Healthy Communities

Engage

Explore the importance of taking care of our natural environment to secure access to food using the **Lessons of Our Land: "A Slice of Planet Earth"**

https://lessonsofourland.org/wp-content/uploads/2017/09/A-Slice-of-Planet-Earth-Lesson-Plan.pdf

This lesson introduces students to the importance of supporting our food webs and ecosystems by modeling the percentage of farmable land using an apple.

Explain to students that because so little of our world is actually inhabitable by humans, it is important that we take care of our planet and natural resources in order to have the food and other resources we need to survive.

Explore

Remind students of the "**Biodiversity Ecosystems and Ecological Networks**" Edpuzzle they completed earlier in the unit. Review the meaning of biodiversity.

Revisit the **Ecosystem Sample 1 and 2**, reviewing what students already know about ecosystem and food web resiliency. You may want to ask students where they see the keystone species in the examples, if they think there is enough biodiversity in the food web, etc.

Note: Students may want to take out their notes on keystone species and energy transference to support them through this activity.

Explain

Explain to students that in order to have strong, resilient food webs, ecosystems must maintain biodiversity. Biodiversity means having a wide variety of organisms that provide opportunities for energy transference. Biodiversity supports the food web by helping maintain and contain species populations.

For example, predators help control the population of their prey by consuming only as much of that prey as is sustainable for the ecosystem. Animals that consume plants support plant species by consuming that plant in just the right amounts so that the population does not grow out of control.

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Healthy Ecosystems Feed Healthy Communities

When the food web is out of balance, organism populations may grow out of control, or become overconsumed and disappear.

Elaborate/ Extend

Pass out the **Oak Woodland Ecosystem Cards**, and the **Food Web Resiliency Directions**.

In **groups of 2-3**, have students read through the direction sheet together. Notice the list of helpful materials in case students want to use work from previous lessons for reference.

Pass out a piece of large paper. Provide students 25 minutes to draw their ecosystem, focusing on designing a strong, resilient food web. Remind students to draw lines and arrows to show energy transference.

Pass out the **Scenario Notetaker**, and the **Resiliency Rubric**. Walk students through the first scenario, modeling your thinking for them. Refer to the **teacher version** of the Scenario Notetaker for suggestions.

Evaluate

Once students have analyzed the impact of the scenarios on their food web, ask students to assess the resiliency of their ecosystem using the **Resiliency Rubric.** Students are assessing their ecosystem in a general way, not necessarily for each scenario.

Explain to students that the scenarios included in the lesson are all realistic and can occur in the Oak Woodlands Ecosystem. Because of this, we want our ecosystems and food webs to be able to withstand all of the scenarios.

Finally, review the following questions with students:

1. **Which scenario impacted your ecosystem's foodweb the most? Why do you think that is?**
2. **How could you have designed your ecosystem differently, in order to strengthen your foodweb?**
3. **Were any species populations eliminated from your ecosystem during scenarios the scenarios?**

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Lesson Resources

Supporting resources for educators:

- **Lessons of Our Land:** https://www.lessonsofourland.org/wp-content/uploads/2017/09/A-Slice-of-Planet-Earth-Lesson-Plan.pdf

Lesson Materials:

- **Ecosystem Example Photos 1 and 2**
- **Oak Woodlands Eocsystem Species Cards**
- **Scenario Notetaker**
- **Scenario Notetaker- Teacher's Guide**
- **Resiliency Rubric**
- **Lessons of Our Land:** https://www.lessonsofourland.org/wp-content/uploads/2017/09/A-Slice-of-Planet-Earth-Lesson-Plan.pdf

Sources:

- https://www.dictionary.com/

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Healthy Ecosystems Feed Healthy Communities

Learning Standards

CA Indian Essential Understandings

Essential Understanding 3: Tribal traditional beliefs and practices, including links to spirituality, are practiced in communities where the culture, traditions and languages are vibrant parts of daily life.

- This lesson builds towards Essential Understanding 3 by introducing students to some of the most important plants and animals in the indigenous ecosystem, specifically focusing on the Black Oak, which produces the staple food of the Pomo people.

Essential Understanding 4: California Indian peoples' histories and cultures have been and continue to be impacted by foreign, state, and federal policies.

- This lesson builds towards Essential Understanding 4 by introducing some of the impacts that settler communities and climate change can have on Native food webs. The preceding lesson goes into further detail.

CA Content Standard

Common Core

WHST .6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content

RST .6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flow chart, diagram, model, graph, or table

NGSS Standards

Performance Expectations:

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

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Healthy Ecosystems Feed Healthy Communities

Science and Engineering Practices:

Developing and Using Models

(MS-LS2-3) Modeling in 6–8 builds on K –5 experiences and progresses developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe phenomena.

Analyzing and Interpreting Data

(M S-LS2-1) Analyzing Data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

Core Disciplinary Ideas:

M S-LS2: Interdependent Relationships in Ecosystems

Organisms,and populations. Organisms are dependent on their environmental interactions both with other living things and with nonliving factors.

MS-LS2-5. LS4.D: Biodiversity and Humans

Changes in biodiversity can influence humans' resources, such as food, energy,and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling.

Crosscutting Concepts:

Patterns

Patterns can be used to identify cause and effect relationships. (M S-LS 2-2)

Cause and Effect

Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)

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Energy and Matter

The transfer of energy can be tracked as energy flows through a natural system. (MS- LS2-3)

Stability and Change

Small changes in one part of a system might cause large changes in another part. (M S - LS 2-4),(M S -LS2-5)

California Environmental Principles and Practices

Principle 1 - People Depend on Natural Systems

The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.

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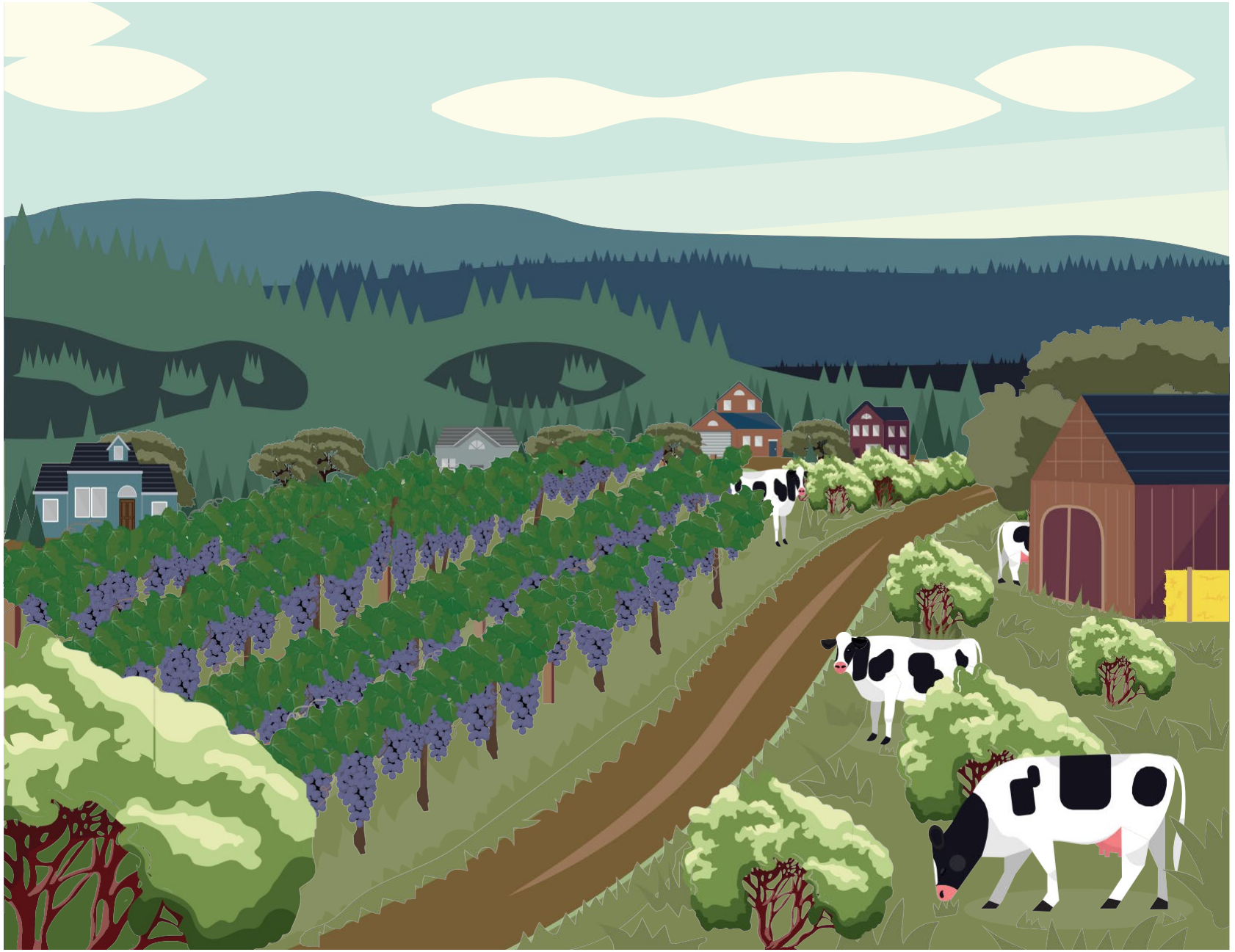
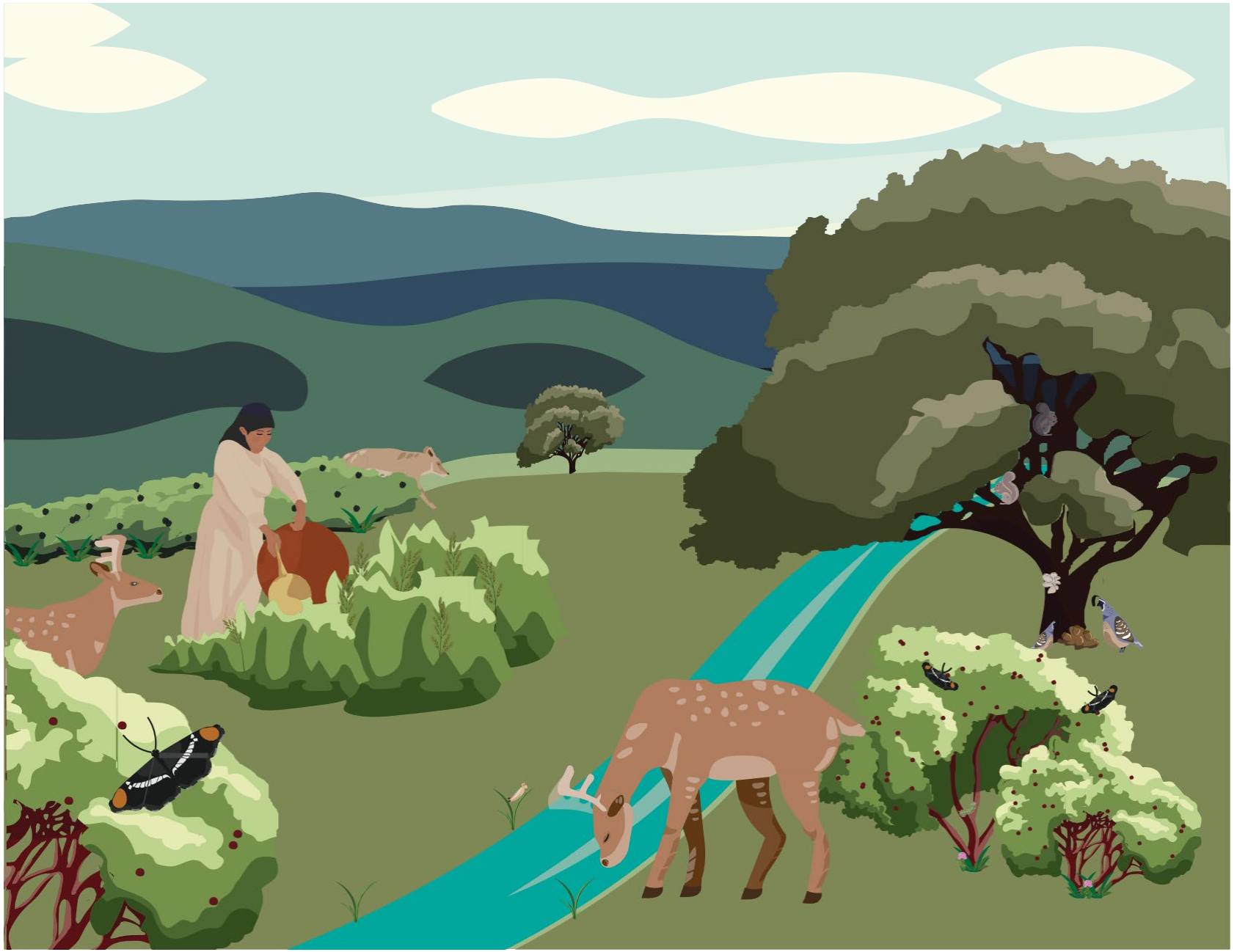
Ecosystem Sample 1



Ecosystem Sample 2



Name:_____ Date:____/_____/_____

Food Web Resiliency Pt. 1

As a new expert in ecosystems, food webs, and energy transference, you know how important it is to live in an ecosystem that can withstand challenges. As we learned in our **Keystone Species Card Game,** events that impact certain organisms in our ecosystems can have huge effects on the entire food web. These effects can range from shifts in food accessibility, species extinction, and even complete ecosystem collapse!

Today, your job is to use your knowledge to **design a resilient ecosystem** that can withstand potentially harmful events. Using your **Oak Woodlands Ecosystem Cards,** work with your team to draw your ecosystem, creating the strongest food web possible. Once your ecosystem is designed, your teacher will introduce scenarios with which you will test and assess the strength of your ecosystem's food web. Good Luck!

Step 1: Using your Oak Woodland Ecosystem Cards, design a resilient ecosystem that meets the requirements below.

Requirements:

1. At least one of each species from your cards.
2. Labeled number of each species.
3. Lines and arrows marking energy transference.
4. A sun and waterways.

Helpful materials:

1. Oak Woodland Ecosystem Cards
2. Keystone Species Food Web
3. "Where do I Live" Map
4. Energy Transfer Pyramid

Step 2: In 2-3 sentences, explain why you think your ecosystem has a strong food web. Include the following vocabulary words: **biodiversity, consumer, producer, predator, prey.**

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Food Web Resiliency Pt. 1

Name:_____ Date:____/_____/_____

Directions: Read the following scenario. With your group, discuss how each scenario would impact the food web in your ecosystem. Consider how organism populations would grow or shrink in size depending on food accessibility.

Scenario 1: The temperature in the Oak Woodlands ecosystem has risen consistently over the last few years. The summers are hotter, drier, and the heat lasts well into the fall season. Grasshoppers in the Oak Woodlands thrive off heat, and begin producing more and more. Their population quadruples(x4) in size! Grasshoppers love to eat grasses like Brome Grass.

Draw the scenario here:

Analysis: If the grasshopper population expands up to 4x its current size, how will other species be impacted? Which species will grow? Which will reduce in size? Can anything be done to control the grasshopper population? (Card info will help you with this question!)

Examine your group's ecosystem. If this scenario was applied to your ecosystem? What do you think would happen?

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Food Web Resiliency Pt. 1

Name:_____ Date:____/_____/_____

Directions: Read the following scenario. With your group, discuss how each scenario would impact the food web in your ecosystem. Consider how organism populations would grow or shrink in size depending on food accessibility.

Scenario 2: Black oak trees produce acorns that are large, oily, and nutritious. Many species of animal eat acorns because they are tasty and a great source of nutrition and energy, like squirrels, humans, and birds. A new settler community recently moved to the area and cleared out 50% of the oak population in your ecosystem.

Draw the scenario here:

Analysis: If 50% of the Black Oak population is cut down, how is the food web impacted? Which species will grow? Which will reduce in size? Is there anything that can be done to help your food web remain strong?

Examine your group's ecosystem. If this scenario was applied to your ecosystem? What do you think would happen?

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Food Web Resiliency Pt. 1

Name:_____ Date:____/_____/_____

Directions: Read the following scenario. With your group, discuss how each scenario would impact the food web in your ecosystem. Consider how organism populations would grow or shrink in size depending on food accessibility.

Scenario 3: Humans are an apex predator in your ecosystem, which means that they consume lots of organisms, but no organisms consume them (with the exception of decomposers). 75% of your human population was forced to migrate away from your Oak Woodland ecosystem because of repeated extreme weather events.

Draw the scenario here:

Analysis: If 75% of the human population leaves your Oak Woodlands ecosystem, how is the food web impacted? Which species will grow? Which will reduce in size? Is there anything that can be done to help your food web remain strong?

Examine your group's ecosystem. If this scenario was applied to your ecosystem? What do you think would happen?

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Food Web Resiliency Pt. 1

Name:_____ Date:____/_____/_____

Resiliency Rubric

Assess the strength of your food web based on the statements below/

Even with the scenarios, the biodiversity of your ecosystem remains strong.

1 2 3 4 5

Even with the scenarios, organism populations remain balanced.

1 2 3 4 5

Even with the scenarios, the keystone species populations are able to thrive.

1 2 3 4 5

Calculate the average score: _____

0-4	Your ecosystem is collapsing! Food webs have been destroyed and are past the point of being saved.
5-9	Your ecosystem is not very stable, but it may still be possible to save. It might have low biodiversity levels, low population levels among certain organisms, or not enough pathways for energy to flow.
10-14	Your ecosystem has been impacted but is stable. there are still enough pathways for energy to flow and maintain the health of food webs. Your ecosystem has some biodiversity and most population levels among organisms stayed the same.
15-20	Your food web is resilient and strong! It has high levels of biodiversity, population balance, contains enough producers to protect the food web, and has many interactions to keep energy moving between organisms.

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