1.8

Traditional Ecological Knowledge Case Study: Fire

Grade Level

6-9

Subjects

Science

Time Frame

2 class periods

Teacher Materials

- KCET “Cultural Burning” EdPuzzle
- Fire Images 1+2
- Fire Case Study Scenarios
- Ecosystem Images 1+2

In this lesson, students explore the role that fire plays in supporting healthy ecosystems. Students are introduced to an Indigenous approach to caring for the environment and apply these approaches to realistic scenarios.

Teacher Background

Native peoples have cared for the environment using methodologies now referred to as **Traditional Ecological Knowledge**, or **TEK**, since time immemorial. During this time, Natives designed complex, specific strategies for protecting ecosystems, and with those ecosystems, community food webs.

Traditional Ecological Knowledge (TEK) differs from modern Western approaches to land management in that it encompasses all aspects of culture, health, and community life. Culturally significant plants and animal habitats are tended to with care; manipulation of plant species is performed in order to promote diversity and heighten production in order to meet a wide variety of cultural and nutritional needs. Common methods of caring for culturally significant plants include controlled burning, pruning, coppicing, transplanting, weeding, irrigation, and more. All of these strategies combined produced what many refer to as a “well-tended garden” throughout the land now known as California. Tending to the environment was a constant process, that ensured a steady availability of traditional foods and materials used in daily life.

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

1.8 Traditional Ecological Knowledge Case Study: FIre

Healthy Ecosystems Feed Healthy Communities

When colonists and settler communities moved into California, they changed the way that humans interacted with the natural environment. Settlers, including modern conservationists, characterized Native people as lazy, unable to care for the vast "wilderness" in which they lived, and in desperate need of intervention. What settlers did not understand is that the land they were invading had been intentionally changed and cared for in order to support biodiversity, and to reduce the likelihood of natural disasters and ecosystem collapse. California Natives had been successful in securing reliable food sources and creating a natural environment in which abundance was the norm.

Once settlers took hold of California, Native populations were forced from their traditional homelands, moved into missions or boarding schools, sold into slave labor, or murdered. Native communities faced enormous physical and legal challenges when it came to tending the ecosystem and food webs, and settler governments designed new ways to manage the land. Cities and neighborhoods sprung up in the middle of floodplains, forests, and traditional fire paths. Forests and woodlands were cut down for lumber, making room for massive farms and vineyards. Cattle was introduced, as were new grasses preferred by cows. Instead of using fire to support food growth, settler governments tried to suppress fire whenever possible. California now faces a twelve-month fire season with wildfires ever increasing in size-a challenge that has been partially caused by settler dismissal of Traditional Ecological Knowledge.

Today, many tribal communities are revitalizing traditional ecological practices in an attempt to protect the environment from the effects of climate change, restore food webs, and nurture traditional cultural practices.

For Native communities in California, the regular practice of controlled **cultural burning** is essential to nurturing the resources that are required for sustaining life and cultural traditions. **Because cultural burning is a practice that is inseparable from Native culture and is a practice that may vary between tribal communities, it is something that must be taught on the land, by trusted tribal leaders.** However, many settler communities, including people in power, are beginning to explore the concept of **"Good Fire,"** namely, that fire can be harnessed as a way to support the ecosystem and promote food growth. This concept, as you will explore with students in the following lessons, has been understood for thousands of years, and has been proven time and time again to work.

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The use of cultural burning to support habitats happened seasonally and varied in frequency depending on the purpose. Because of the frequent, time specific use of fire, fires rarely grew out of control. While many Californians today associate fire with destruction and fear, it is estimated that the number of acres burned in California annually ranged from 5.6 million to 13 million acres. Most of these acres were burned intentionally for a wide variety of purposes. While different tribes burned for different reasons depending on their local ecosystem, below are some of the common uses of burning for the Pomo people in Northwestern California. This is just a sampling of uses, as there are countless applications of fire in California by Native peoples!

Note: Because of the scope of this curriculum, we do not explain the science of fire in depth, but instead look at the impact fire has on ecosystems, food webs, and cultural resources. To expand upon this unit, we suggest examining the relationship between fuel, oxygen, and heat on fire.

Traditional Uses for Fire:

1. **Antiseptic:** Fire and smoke control the spread of disease, or rust fungus. Rust fungus can spread through tule used for basketry, infecting the plant and making it vulnerable to slugs and useless for making baskets. Smoke is also an antiseptic that can kill disease fungus on the barks of trees, especially oak trees.
2. **Nutrition Support:** Burning, and the ash it produces, cycles nutrients, like phosphorus, through the soil, promoting new growth of a wide variety of grasses. Nitrogen reliant plants like clover (a favorite food), thrive in newly burned spaces where nitrogen is in abundance. Fire also enhanced mushroom populations, on which trees and shrubs depend. Many seeds and grains germinated with greater ease after a fire. In fact, many nitrogen-fixing plants, such as wild peas and other greens, depended on the presence of fire for seed germination.
3. **Population Control:** Grassy areas are burned to drive out and control grasshopper populations, as grasshoppers can easily overpopulate in hot, dry climates and ruin grasslands. Douglas Fir and other conifer trees tend to encroach into Oak Woodlands and coastal prairies. Controlled burning of conifer seedlings prevents encroachment and promotes growth of oaks, grasses, and protects prairie lands. Regular fire also kept insect populations in check, promoting plants growth. For example, oak, hazel, and huckleberry bushes are all burned to reduce insect populations and promote fruit growth.

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4. **Food Growth:** Regular fires are set to prairies, grasslands, and forest floors in order to burn back overgrown brush, tree seedlings, and to reduce forest density and create space for light to shine through to the forest floor. Burning seeded or fully grown plants, such as tar-weed or soaproot, make room for new growth grasses. Clearing the grasslands, forest floors, and Oak Savanna/Woodlands provides oaks more space to grow, enhancing acorn production. Manzanita trees, whose berries are used for cider and whose bark and leaves are used for medicines, were kept apart from another through burning, as they require space to grow
5. **Cultural Materials:** Burning shrubs supports the growth of long, thin shoots, flower stalks, and leaves that can be used for basket weaving. Regular burning prevents brush from becoming tangled and overgrown so that more light can reach the plant and to keep the plant easily accessible to gatherers. Favorite materials include red willow, redbud, ferns, and sourberry. Other cultural materials that relied on burning to produce new, growth include clothing, cordage, musical instruments, weapons, cages, structures, and games.
6. **Gathering Accessibility:** Burning the floor of the Oak Woodlands and Oak Savannas makes gathering acorns more accessible. Burning and pruning back bushes and brush makes gathering foods and cultural materials easier. Trails used to travel, gather foods, and hunt were maintained through regular burning.
7. **Hunting Accessibility:** In areas with high density grasses, burning grasslands can be used to increase the visibility of animals, like dear, making hunting easier. Smoke is used to push animal and insect populations from their homes, causing squirrels, quails, deer, and others to move into spaces where they are more easily hunted.
8. **Protection:** Burning tall grasses in woodlands and forests increases visibility. Having the ability to see through the forest once proved to be important for the safety of Native village encampments. In fact, when the California Grizzly roamed California's landscape, they were humans' top predator.

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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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Engage

Ask students to respond to the following quick write prompt:

We live in a community that experiences fire. What are your experiences with fire?

Explore

Presentation/image analysis:

Project **Fire Images 1+2**. Ask students to answer the following questions as they look at the images:

1. **What variables does fire depend on? What can make them worse?**
2. **Do the forest examples in the photographs look well maintained? How do you think they can be taken care of better?**

Assign the **KCET Episode "Cultural Burning"** and have students complete the EdPuzzle questions. This is a medium-length video and may be best watched as a class in order to promote engagement.

Explain to students that the video shows the Native relationship to fire, and also provides insight into how controlled burning can support our ecosystem.

Edpuzzle Link: https://edpuzzle.com/media/5f2898772b1e-903f2a104eb2

Explain

Create a list of all the facts students learned about fire from the Edpuzzle. Create a list of questions students may have.

Explain that using fire intentionally can support our ecosystem and help it become healthy. One of the reasons that we have massive wildfires in California is because we have let the land go untended and become overgrown for so long. This overgrowth acts as a significant amount of fuel for the fire to burn. Regular pruning of trees and controlled burning during non-fire season can prevent massive fires from occurring.

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Not only can regular controlled fires help prevent massive forest fires, fires can also promote biodiversity. Biodiversity is important for maintaining out food webs, and also creates materials used for cultural purposes like baskets.

Project **Ecosystem sample 1+2.**

Ask students which ecosystem has the most biodiversity.

Point out that **Ecosystem sample 2** is an ecosystem that has had controlled burning, or **"good fire",** applied to the landscape. Because the land has been tended with fire, there is greater biodiversity, more reliable food options, more energy connections between organisms, and overall greater resiliency.

Elaborate/ Extend

Group students together in pairs or groups of 3. Provide students with the **Fire Case Study Scenarios** and a copy of **Ecosystem sample 1 and 2.**

Before walking students through **Scenario A** as a class, brainstorm with students some of the common Native foods they have learned about so far (ie. **Oak Woodland Ecosystem Cards**).

Examples of many of these foods are included in the **Ecosystem sample 2.**

Together as a class, read, draw, and analyze **Scenario A,** noticing how species and food webs are impacted. Notice that students are expected to draw out their interpretation of the scenario in order to support reading comprehension.

Now, apply **Scenario A** to **Ecosystem sample 1.** If fire was applied to the settler ecosystem, how might the ecosystem change?

In their groups, have students work through **Scenario B**, repeating the same process.

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Evaluate

Once students have completed **Scenario B** and worked through their analysis questions, help students apply scenario B to **Ecosystem sample 1**, again exploring how the settler ecosystem would be impacted if fire were applied.

As a class, discuss the following questions:

1. **What are some of the benefits of controlled fires?**
2. **How can using fire strengthen food webs?**
3. **What can happen when we suppress fires?**

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Lesson Resources

Supporting resources for educators:

- **UC Berkeley Oak Woodland Information:** https://oaks.cnr.berkeley.edu/
- **Fire Activity Map,** featured on the UC Cooperative Extension Website. The interactive image shows red flag warning zones, current wildfires, the size of the fire and the percent containment, and the cause: https://ucanr.edu/sites/fire/Safety/Current/
- **Cap Radio California Fire History Map.** This map illustrates the shift in wildfire activity throughout California between the years 1950-2018. Notice that in the fifties, fires were must smaller and more spread out. In the 60's-early 80's, the fires reduce in number, but the intensity is worse. In the late 80's, the fires start getting larger, and are more damaging.: https://projects.capradio.org/california-fire-history/#6/38.58/-121.49
- **Mercury News- CA Fire History in 1 minute.** This time lapse highlights the increased number of fires, and the increased destruction of those fires, between the years 1900 and 2018. It also highlights the three main reasons for increase fires: population growth, fire suppression, and climate change: https://www.mercurynews.com/2019/10/29/watch-118-years-of-california-wildfires-in-1-minute/
- **NewsELA The Role of Wildland Fires in an Ecosystem.** This article emphasizes that fire needs fuel, heat, and oxygen to function, and explores ways that ecosystems are impacted by fire.: https://newsela.com/read/govt-science-wildfires/id/24569/?collection_id=2000000192&search_id=d55e3497- 4802-4c34-b155-fe7577f49fe8
- **Wired article: The Quiet Intentional Fires of Northern California.** This article highlights the work of the Yurok-led Cultural Fire Management Council and the Nature Conservancy's Fire Learning Network. It provides a strong example of Native-led efforts to protect and restore foodwebs and cultural resources: https://www.wired.com/story/the-quiet-intentional-fires-northern-california/

Sources:

- Tending the Wild by Kate Anderson
- Tribal interviews- California Indian Museum and Cultural Center

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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.

Essential Understanding 5: Land and place are unique and inextricably tied to tribal cultures.

Essential Understanding 6: Written histories are most often codified through the subjective experience of the historian. Tribal histories are being rediscovered and revisited. Tribal perspectives of historical events often conflict with textbook histories.

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.

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.

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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)

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)

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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.

Principle 2 - People Influence Natural Systems

The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.

Concept A. Direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems.

Concept B. Methods used to extract, harvest, transport, and consume natural resources influence the geographic extent, composition, biological diversity, and viability of natural systems.

Concept C. The expansion and operation of human communities influences the geographic extent, composition, biological diversity, and viability of natural systems.

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Name:_____ Date: ____/_____/_____

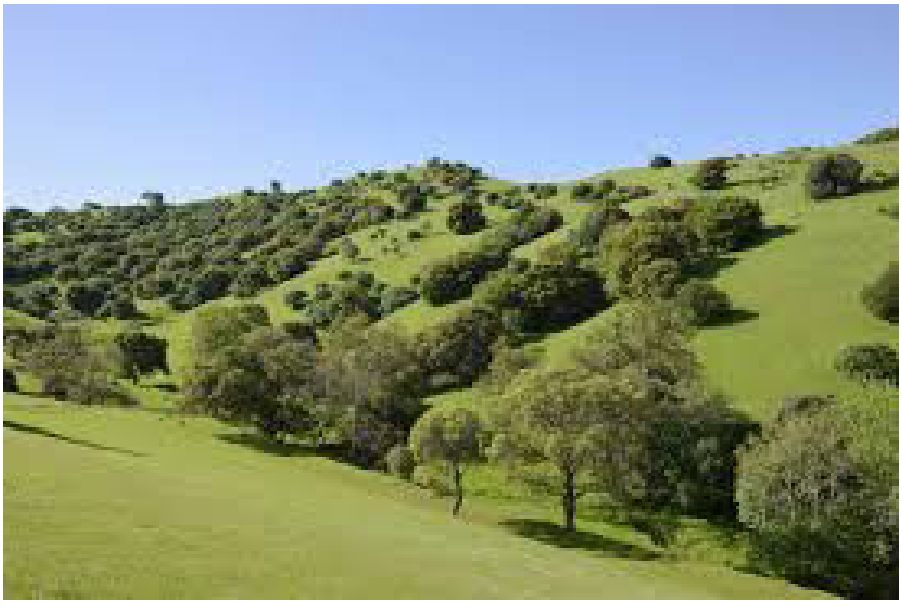
CA Images 1&2

IMAGE 1: (SOURCE: PRESS DEMOCRAT

This image features an oak woodland forest in Sonoma County, California. Notice that the trees' branches are low to the ground, along with miscellaneous brush, creating a fire hazard. There are conifer trees that have grown in between the oak trees. They appear to be dead. Having trees so close to one another, and especially dead ones, presents a fire hazard.

IMAGE 2: (RESEARCH GATE)

This image features an oak woodland in Northern California. Notice that the trees are fairly spread apart, and that you can see right through the trees. There are no low lying branches, and there are no dead trees creating additional fuel sources.



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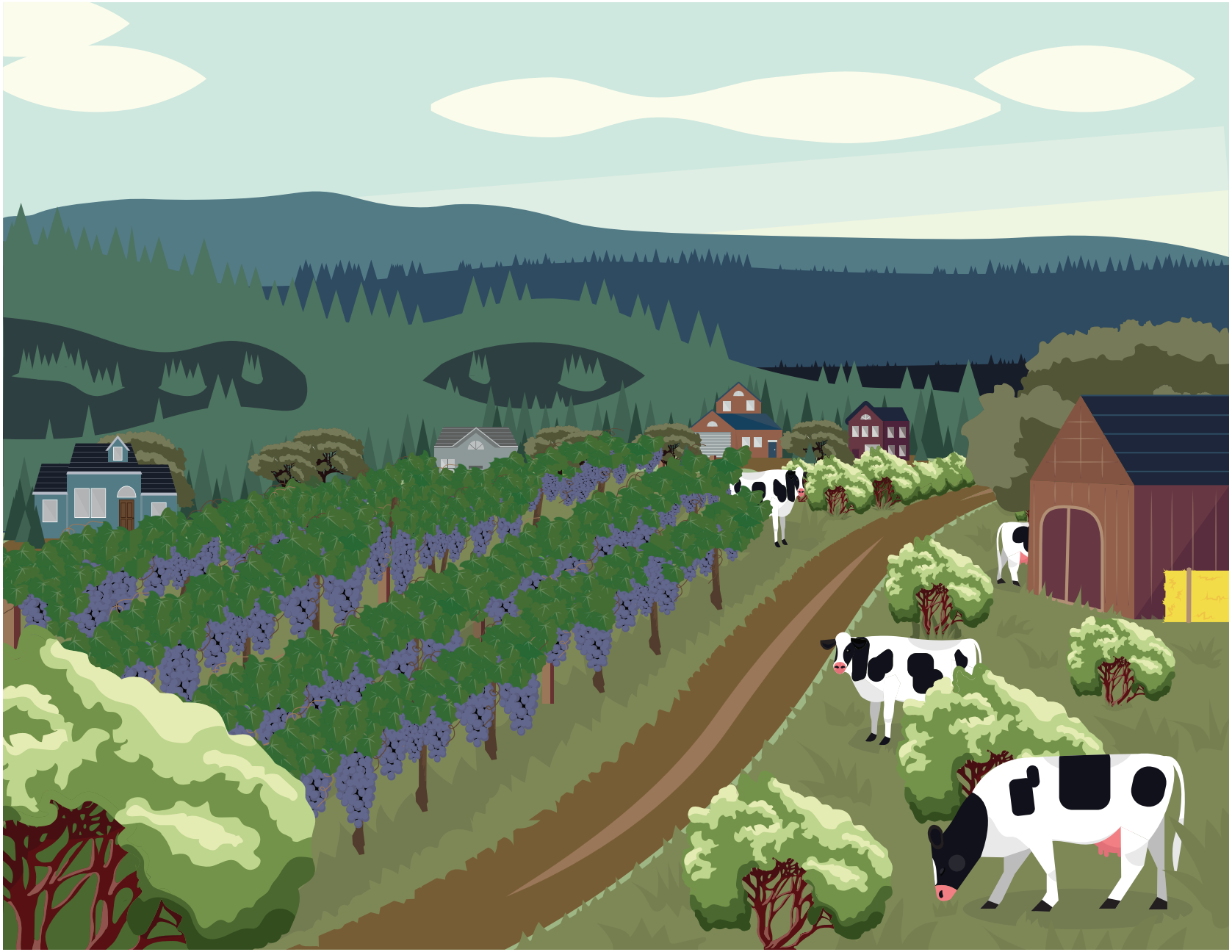
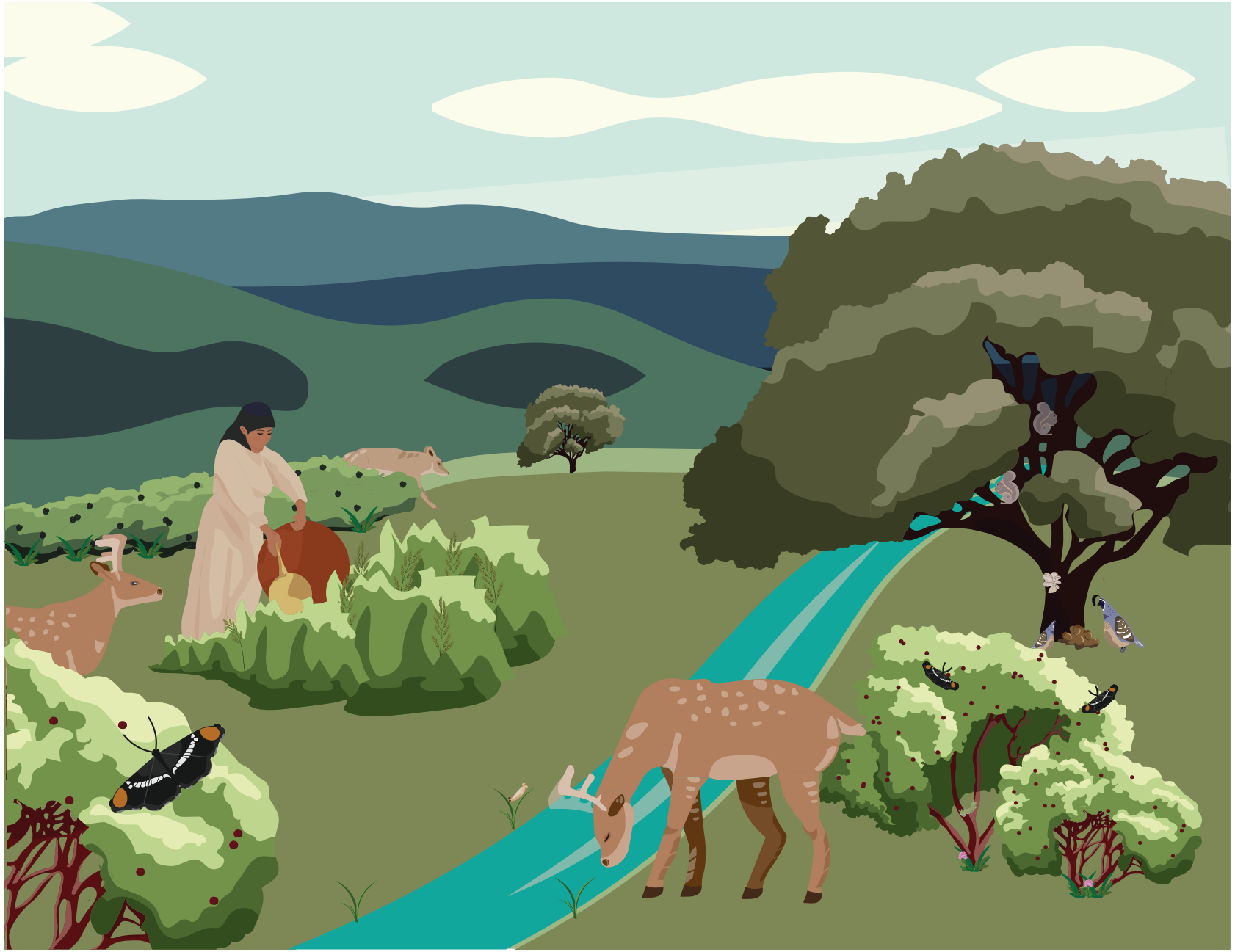
Ecosystem Sample 1



Ecosystem Sample 2



Fire Case Study Scenarios

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 A: Acorns are a popular and nutritious food for Native people and many other animal species. Insects especially love acorns, and sometimes eat so many that the acorn crop is ruined with insect holes and rot. Native people traditionally burn the ground under the oak tree in order to kill insects and worms that live on or around the oak tree. This helps keep the acorn crop healthy and abundant for humans and other species.

Draw the scenario here:

Analysis:

1. What purpose does fire serve in this scenario?
2. How is the insect population impacted in this scenario?
3. Why is having too many insects harmful to the Oak Woodland food web?
4. How are traditional Native foods supported by fire in this scenario?
5. If the burning technique in Scenario 1 was applied to the ecosystem in **Ecosystem sample 1**, how would the ecosystem change or be impacted? What changes could possibly occur?

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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 B: Because oaks are a keystone species in the Oak Woodland Ecosystem, it is important to take care of them. In order to grow big and produce lots of acorns, oaks need space to spread out. To make sure oaks have enough space to expand, Native people traditionally use fire to burn any brush, grass, or sprouting trees that crowd the trunk of the oak tree. When the trunk of the oak is cleared, the oak grows bigger, and all the species that rely on the oak benefit.

Draw the scenario here:

Analysis:

1. What purpose does fire serve in this scenario?
2. How is the insect population impacted in this scenario?
3. Why is having too many insects harmful to the Oak Woodland food web?
4. How are traditional Native foods supported by fire in this scenario?
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California Indigenous Foods

Below is an incomplete list of foods indigenous to California. All tribal communities have different traditions and norms regarding what they eat, how, and when. Just because one tribe consumes one food does not necessarily mean another tribe does.

Fruits and Vegetables:
tarweed
wild grapes
cacti
cherries
wild plums
wild strawberries
wild raspberries
wild blackberries
wild apricots
thimbleberries
sourberry
Manzanita
California fan palm
prickly pear cactus
elderberry
huckleberry
wild onion
agave
yucca
Dandelion
wild celery
clover
cattail
milkweed
Indian rhubarb
Watercress
water parsley
bracken fern

Proteins:
walnut (fat, protein)
hazelnut (fat, protein)
buckeye (fat, protein)
acorn (fat, protein)
pine nut (fat, protein)
deer
elk
antelope
mountain sheep
quail
grasshoppers
salmon
mussels
seaweeds
clams
scallops
trout
sturgeon
abalone

Grains and starches:
brome grass (carb, whole wheat)
oats (carb, whole wheat)
ricegrass (carb, whole wheat)
chia seeds
Buckwheat
Bear-grass
yampah

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