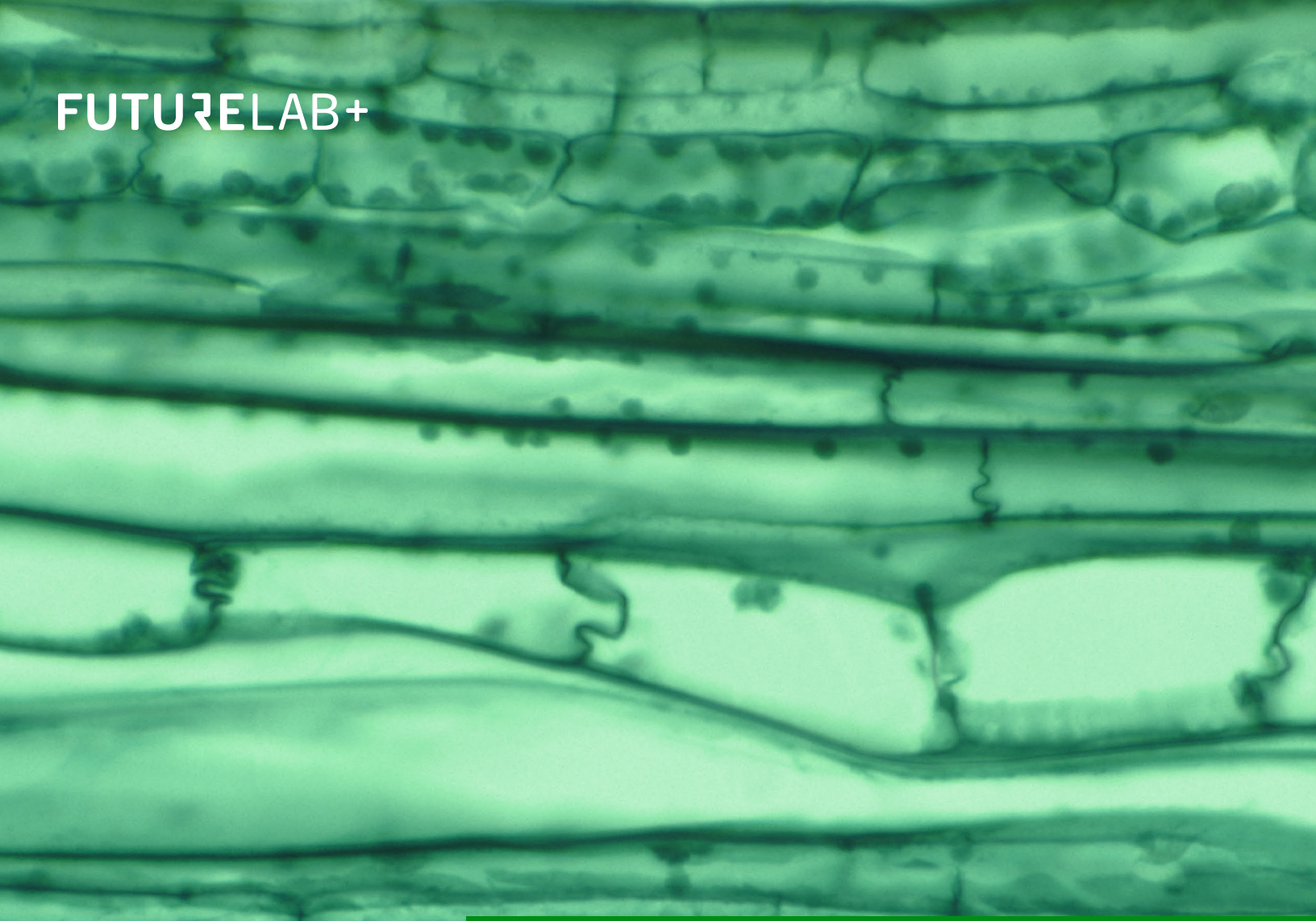
FUTURELAB+



AG/ENVIRONMENTAL

Plant to Pharmaceutical

The Role of Traditional Ecological Knowledge in Drug Development

Developed in partnership with:

Discovery Education and Ignited

In this Lesson Plan:

Print the **Teacher Section** →

Print the **Student Section** →

This document is separated into two sections, For Teachers [T] *and* Student Resources [S]*, which can be printed independently.*

Select the appropriate printer icon above to print either section in its entirety.

Follow the tips below in the Range field of your Print panel to print single pages or page ranges:

Single Pages (use a comma): T3, T6

Page Range (use a hyphen): T3–T6

Cover Image
The Solanaceae plant family is rich in bioactive metabolites and has played an essential role in traditional medicine.

AG/ENVIRONMENTAL / PLANT TO PHARMACEUTICAL

The Role of Traditional Ecological Knowledge in Drug Development

DRIVING QUESTION

How can a community medicinal plant garden promote health and healing?

OVERVIEW

Many pharmaceutical companies have partnered with Indigenous communities who have Traditional Ecological Knowledge (TEK) to identify plants that may address particular diseases. However, Indigenous communities who traditionally utilize these plants medicinally may view the relationship between health, medicine, and disease in a different framework. Students will explore how Indigenous definitions of disease and health differ from those used in Western medicine and how integrating these views might provide benefits for all of humanity while promoting positive and successful collaborations.

In this lesson, students will investigate approaches to preventive healthcare using whole plant medicines by researching bioactive plants, their Indigenous uses, and how they benefit health and well-being in addition to allopathic uses. They will learn about the Traditional Ecological Knowledge that has provided scientists and pharmaceutical companies with information on plants with compounds useful in promoting health and treating disease. They will have the opportunity to select a health issue prevalent in their lives or community, or a body system of particular interest, and design a plan for a medicinal garden.

ACTIVITY DURATION

Five class sessions
(45 minutes each)

ESSENTIAL QUESTIONS

How do different communities define disease and health?

What does healing in your focal community mean?

How are herbal remedies used proactively for health?

OBJECTIVES

Students will be able to:

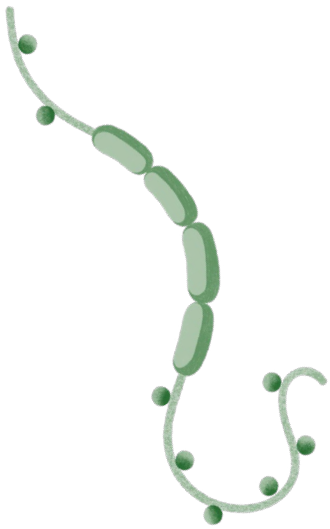
Describe Indigenous Traditional Ecological Knowledge.

Design a medicinal plant garden to address community needs.

Collaborate to identify and narrow down specific medicinal plants for a patient population identified by the student group.

Provide feedback to other student groups.

Deconstruct a primary literature search and identify key ideas and concepts in a collaborative group.



Materials
Student Guide
Tending Nature Reading
Tending Nature Capture Sheet
TEK Jigsaw Capture Sheet
TEK Article Excerpts
TEK Article Excerpts—Highlighted and Annotated
Plant Profile Slide
Medicinal Plant Profile Capture Sheet
Common Medicinal Plant Menu
Medicinal Community Garden Design Capture Sheet Template
Plant Profile Gallery Walk Student Capture Sheet
Internet Access
Computer
Optional: Paper, Pens, Dry Erase Board
Sticky Notes

Pedagogical Framing

Instructional materials are designed to meet national education and industry standards to focus on in-demand skills needed across the full product development life cycle—from molecule to medicine—which will also expose students and educators to the breadth of education and career pathways across biotechnology.

Through this collection, educators are equipped with strategies to engage students from diverse racial, ethnic, and cultural groups, providing them with quality, equitable, and liberating educational experiences that validate and affirm student identity.

Units are designed to be problem-based and focus on workforce skill development to empower students with the knowledge and tools to be the change in reducing health disparities in communities.

SOCIAL-EMOTIONAL LEARNING

Students will develop social awareness by practicing empathy and compassion as they select plant species for a community medicinal garden to support health in their community. Students will engage in responsible decision making by making constructive choices, and evaluating benefits and consequences for collective well-being of self and community. Students will build relationship skills by collaborating with their group and designing a medicinal garden with a health focus of their choice.

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

Students have the opportunity to collaborate with families and the local community to determine a particular health issue of concern and select plants that are significant to them personally, culturally, or as a community. Students may draw on personal cultural beliefs when studying the spatial perspective that Indigenous communities practice in their relationship with living and nonliving elements on Earth. Students can frame their learning through their own cultural lens, and learn about the cultural practices of others as they share Indigenous connections to the plants selected for their garden.

ADVANCING INCLUSIVE RESEARCH

In this lesson, students explore Traditional Ecological Knowledge and the role of Indigenous communities in identifying plants that may have medicinal applications. Indigenous communities often have a deep cultural knowledge of medicinal plants. This serves as a framework for identifying compounds that can be useful in new drug development as scientists search for novel bioactive treatments. By generating equitable benefits sharing agreements, pharmaceutical companies and researchers have the opportunity to honor the foundational knowledge and experience of Indigenous communities.

COMPUTATIONAL THINKING PRACTICES

Using collaborative technologies, students will consider Western viewpoints and TEK (Traditional Ecological Knowledge) viewpoints as they research and locate information from digital resources. Students will analyze digital information to design an innovative artifact in the form of a medicinal garden plan. Ideas will be communicated in a digital model.

CONNECTION TO THE PRODUCT LIFE CYCLE

During the drug target identification process, scientists often build on TEK to isolate particular compounds from plants with bioactive properties. By isolating the specific medicinal compound, scientists can start the process of preparing the medicine for clinical trials, a key part of product **development**.

Have you ever wondered…

How have Indigenous communities utilized plants to heal humans over time?

Indigenous communities define wellness and disease in different ways from Western scientists. Some Indigenous communities view human health in the context of a relationship with environmental health. Indigenous healers and community leaders address both in proactive ways to prevent illness and sustainably manage environmental resources. When illness does arise, Indigenous communities maintain diverse strategies to address symptoms and treat the cause of the illness using a whole plant perspective.

How can whole plants address human diseases and symptoms?

Different parts of plants can be used to address ailments and their symptoms. Historically, Indigenous communities across the globe have utilized parts of whole plants to create medicines—the whole plant perspective rather than a single, isolated plant compound. Instead of taking a pill, they consider how a medicinal tea or salve could be used to treat a condition. Traditional plant medicines are often more accessible to larger populations and are widely used by 60% of humans on Earth. (Source: *WHO's Biodiversity and Health*)

MAKE CONNECTIONS!

How does this connect to the larger unit storyline?

Students will explore diverse models of disease, health, and treatment and see models of their final product (a plant that could be used to treat disease) connected to its cultural context.

Students' prior knowledge of stakeholders, intellectual property and ethical collaboration, and ecosystem structure (biotic and abiotic factors and their impact on biodiversity of plants) will aid them as they profile a particular medicinal plant and highlight the Indigenous cultural connections and ecological practices associated with that plant.

This profile also provides a foundation for the Kirby Bauer assay by connecting students with the biological function of different plant-based medicines from a whole plant perspective.

Finally, this lesson provides students an opportunity to connect with plants from an Indigenous way of knowing and a whole plant medicine perspective prior to exploring phytochemistry and plant-based compound medicines.

How does this connect to careers?

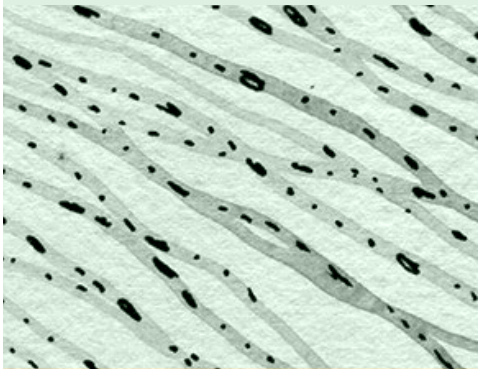
Traditional or naturopathic medicine practitioners integrate both scientific and holistic understandings of health and traditional medicine into their practice with patients. Licensure requires earning a degree from an accredited naturopathic medical school and passing licensing exams.

Scientific illustrators collaborate with researchers, designing two- and three-dimensional models with the end audience in mind. By creating digital or paper illustrations, they are able to enhance written communication so that viewers speaking different languages can engage with the relevant scientific concept, idea, or process.

How does this connect to our world?

Students will explore plants (resources provided, or one of particular interest to the student) to learn about their health properties from an Indigenous perspective and from a chemistry perspective (what is the bioactive compound, if known)?

Students will also engineer and pitch a medicinal garden design, with a focus of their choice, for a patient population they have identified.



Day 1

Procedure

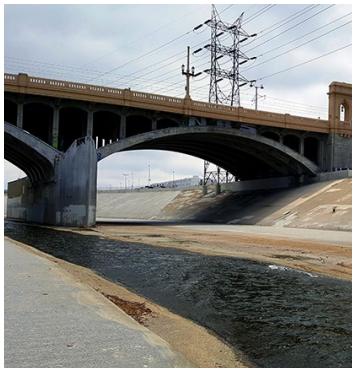
LEARNING OUTCOMES

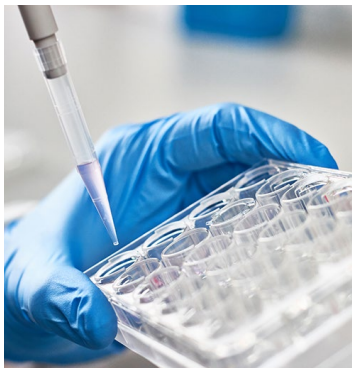
Students will be able to:

Identify the original stewards of their local community.

Explore Indigenous communities' influence in medicinal horticulture and the continued influence of Traditional Ecological Knowledge (TEK) on biochemical research.

Investigate a case study on holistic healing and ancestral medicine.





Whole Group (10–15 minutes)

1 As a class (or individually), ask students to use *Native-Land.ca* to find their home or school address and then do a land acknowledgement of the Indigenous community(ies) that traditionally lived on that land. The goal for this introduction is to prompt students to briefly reflect on the traditional inhabitants of their region.

a. Which groups are native to a region?

b. How might they have interacted with the environment, including local waterways and forests? What might the area have looked like before being urbanized?

Teacher Note > *This lesson will build out the unique perspectives and ways that Indigenous communities have lived among and interacted with all parts of the environment, including plants used for health and medicine.*

2 Explain to the class that they will examine a resource regarding Chumash tribe members and their connection to a traditional outdoor space containing medicinal plants in Santa Barbara, California. They will explore how one of the hundreds of Indigenous communities in North America envisions human health and healing and its connections to ecological health. Note that each Indigenous group or tribe may have unique views on these definitions, so this is a single, non-representative case study.

3 Share with students that Indigenous groups have held knowledge of medicinal plants and their applications for centuries. Through collaboration with Indigenous Traditional Ecological Knowledge (TEK) practitioners, scientists have the opportunity to learn from the wealth of experience and understanding of ecosystems and collaborate to identify new plant-based medicines. Large assays (procedures that test substances for biochemical components) screening many plants for bioactive properties can be more successful and productive when based on information from known uses in traditional practices. Share with students that they will use a similar assay to test a plant of their choosing for antimicrobial activity (one form of bioactivity) during the lab: Drug Discovery Using Plant Extracts.

Continues next page >

Day 1

Continued

Procedure

Whole Group or Small Group (25 minutes)

1 Either as a whole class or in small groups, read and explore the *Tending Nature Reading*. Students may work individually or in small groups to complete the *Tending Nature Capture Sheet*. Capture sheet will include prompts for:

a. How does the article compare and contrast use of medicinal plants as a preventive health practice compared to "allopathic" medicines?

b. How was an "allopathic" medicine described?

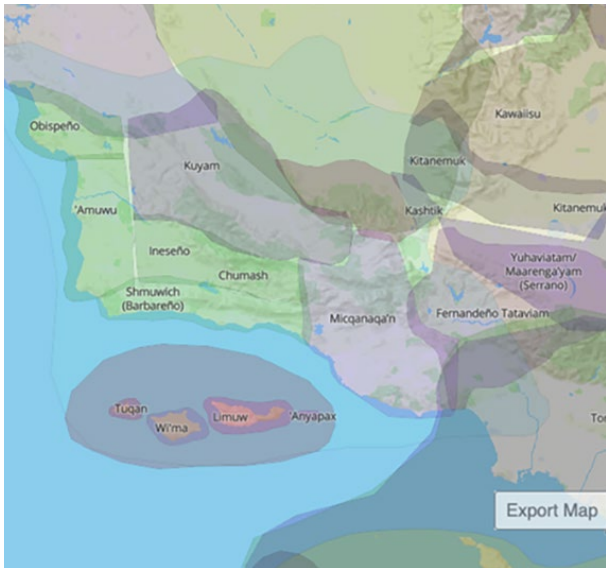
c. Who owns or holds rights to TEK?

d. Why are whole plant medicines described as health practice "from the soil up?"

Whole Group (5 minutes)

Students share their key takeaways from their exploration of the reading.

Native Lands near Santa Barbara, California



Different colored shading represents traditional lands of Indigenous communities

Teacher Note > *As an exit ticket (if time permits) or as homework, students should add to their **Student Guide** by completing the first question for Lesson 4.*

Day 2

Procedure

LEARNING OUTCOMES

Students will be able to:

Discuss Indigenous perspectives of "home" and place.

Explore Traditional Ecological Knowledge (TEK) and how this applies to collaborative efforts, such as benefits sharing agreements.

Deconstruct a primary source through collaboration and identify common themes by employing context clues.

Whole Group (15 minutes)

1 Warm up the class by leading a whole group discussion or facilitating a timed write of the following guided questions:

How would you define your home? Does it include:

- The physical place you live in? A feeling?
- Your neighborhood?
- Your community or other group of people?
- The natural environment?

Teacher Note > *The goal of the warm-up question is to encourage students to consider that there are different ideas and definitions about what the term "home" may mean. For Indigenous communities, "home" includes the natural environment and everything in it. Introducing Indigenous perspectives on plants will be important for students to better understand the concept of Traditional Ecological Knowledge, as well as the need for appropriate benefits sharing agreements when working with Indigenous communities.*

2 Introduce to students that they will "jigsaw read" a primary literature article excerpt about Traditional Ecological Knowledge (TEK). When pharmaceutical companies collaborate with Indigenous communities regarding knowledge and use of TEK, documents called benefits sharing agreements are created to ensure that Indigenous knowledge is accessed appropriately, used fairly, and compensated equitably. To successfully do so, it is important to understand the differences between Western thought and Indigenous TEK, and how they can work together.

Continues next page >

Day 2

Continued

Procedure

3 Provide students with the *TEK Jigsaw Capture Sheet* and the reading (see options in Teacher Note). Ask students to focus on these key questions below as they engage with the reading:

- How do Indigenous beliefs differ from contemporary Western beliefs regarding management of the natural world and "physical space"?
- What is meant by the basic TEK concepts of "All things are related" and "All things are connected"?
- What are some key beliefs held in TEK ways of thinking?

Teacher Note > *Primary literature sources can be challenging to read. Provide these three options to students:*

a. The full primary literature article: Traditional Ecological Knowledge: The Third Alternative.
b. The TEK Article Excerpts for a focused version of the primary lit text specifically tailored to the capture sheet.
c. The TEK Article Excerpts—Highlighted and Annotated to support students who may struggle to engage with challenging text, or as an example of how to engage with the text for the entire class.

Individual Work (20 minutes)

1 Transition students into article groups (suggested group size of three). Assign each group member one section of the article to read:

a. Space, Time, and Traditional Knowledge.

b. Traditional Knowledge & Ecological Concepts.

c. Conclusions.

Teacher Note > *The Conclusions section is the shortest of the three.*

2 Students will individually complete the first section of the *TEK Jigsaw Capture Sheet*. The Abstract and Introduction section of the *TEK Jigsaw Capture Sheet* are filled in to serve as a guide.

Small Group (10 minutes)

Students will share main points from their reading, and group members will record any new key takeaways from the other two sections that they have not already written down.

Teacher Note > *As an exit ticket (if time permits) or as homework, students should add to their **Student Guide** by completing the second and third questions for Lesson 4.*

Day 3

Procedure

LEARNING OUTCOMES

Students will be able to:

Explore further the concept of medicinal gardens.

Research and plan gardens supporting general well-being or specific body system health.

Construct a plant profile that focuses on Indigenous historical use.

INDUSTRY AND CAREER CONNECTION

Traditional or naturopathic medicine practitioners integrate both scientific and holistic understandings of health and traditional medicine into their practice with patients. Licensure requires a degree earned from an accredited naturopathic medical school and passing licensing exams. Students will investigate this career by researching whole plant medicines that serve a preventive purpose as well as for treatment of an ailment.

Whole Group (15 minutes)

1 Class brainstorm reviewing ideas about tending plants and using them medicinally to promote health maintenance shared in the *Tending Nature Reading*.

2 The following are main ideas shared by the Syuxtun Collective in Santa Barbara, California, that students were prompted to identify. Share with students any missing pieces from the brainstorm.

- We can live in preventive ways to reduce our need for allopathic medicines, which are medicines that treat symptoms when an individual has developed a health issue or illness.
- Tending the land, plants, and animals as a system is essential to the health of the whole plants we seek to promote human health.
- Plant health tells you about the health of the environment and the impact on biodiversity.
- TEK is held as a collective property.
- Whole plant medicines are not a quick fix to a symptom, but a health practice "from the soil up."

3 Introduce the student design "mini-project" of creating a medicinal garden that focuses on general health needs or a particular body system, such as the respiratory or digestive system. Students will create a 2-D model of a garden design for medicinal plants and a brief profile of a potential patient or user population. In groups, students will research plants with health benefits and select ones for their community garden.

Teacher Note > *2-D model option format may include:*
a. digital
b. paper
c. white board
e. Tinkercad (if available)
f. teacher or student choice

4 Share with students that Indigenous communities globally still maintain medicinal garden spaces, and that these are valuable healthcare resources. Historically, Western nations used TEK to create and maintain medicinal gardens during times of war to treat soldiers. A quick Internet research using key words and phrases such as Indigenous medicine garden, medicinal garden, Civil War, WWI, and WWII will provide several examples and history if students are interested in some resources.

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Day 3

Continued

Procedure

Small Group (30 minutes)

1. Create small "garden project groups" of approximately four students. Within each group, each student should select a different plant. Students may select a plant from the *Common Medicinal Plant Menu*, or choose a plant of personal interest. If necessary, assign plants to save time. Scaffold for student needs and ensure a wide variety of plant choices with few duplicates.

2. Individually, students will complete the *Medicinal Plant Profile Capture Sheet*, including this basic information:

   a. Plant role in health or healing (what symptoms or ailments has it been used to treat?)

   b. Bioactive compound (use *Medicinal Botany—Active Plant Ingredients* as a resource)

   c. Dosage and known toxicity

   d. Preparation information

   e. Plant growth needs (regionally native plants will thrive well with other members of the local ecosystem)

   f. Connections of Indigenous TEK and use

Teacher Note > *This plant profile focuses on plants that have an Indigenous history of use for promoting health or treating health issues with a whole plant approach (i.e., teas, tinctures, oils, balms, salves). Students are meant to gain knowledge of types of ailments that plants may treat and exposure to different medicinal plants. In Lesson 6, students will again research a medicinal plant, but will focus on the bioactive compounds that can be used in pharmaceuticals to treat a disease or symptom.*

Day 4

Procedure

LEARNING OUTCOMES

Students will be able to:

Explore community medicinal garden planning through a gallery work of peers' plant profiles.

Collaborate to plan a medicinal garden based on specific plant profiles and specific health outcomes.

Identify potential users of specific plant profiles and medicinal gardens.

Teacher Note > *If desired, enlarge the Medicinal Community Garden Design Capture Sheet in advance for students to see how they will be able to plan their garden space. If possible, print student plant profiles and post around the classroom for a gallery walk or display them digitally.*

Whole Group (15 minutes)

1 Ask students to quickly brainstorm any possible health needs that exist in their community to help focus their thinking about useful medicinal plants. For example, do students know of:

- People who have inflammatory ailments such as asthma, digestive issues, autoimmune disorders?
- Elder care facilities with clients who may have aging-related health issues?
- A local hospital with a cancer center?
- A local dialysis center?

2 Have students move about the room and scan plant profiles through the lens of what they might like to have in their medicinal community garden. Have students note three to five plants of interest on their *Plant Profile Gallery Walk Student Capture Sheet* in the top table. Students should consider the following questions as they view the profiles:

- What health needs exist in your community that a medicinal plant could support?
- Which plants that support health maintenance were interesting to you?
- Which plants would thrive in your growing zone? Use the *USDA Plant Hardiness Zone Map*.
- Which plants would help with a health issue or body system that you are interested in (asthma, respiratory health, digestive health, mental health, etc.)?

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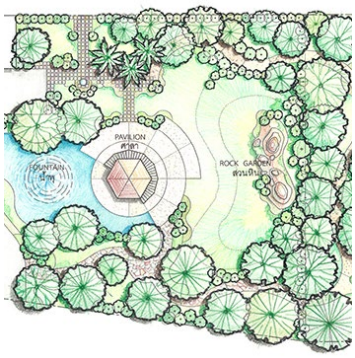
INDUSTRY AND CAREER CONNECTION

Scientific Illustrators collaborate with scientists and engineers to create 2D and 3D representations to better communicate complex information with diverse stakeholders. Scientific Illustrators use a diverse set of technical tools to create their work, from pen and paper and sculpting materials to digital illustration and design tools.



Day 4

Continued

Procedure

Small Group (15 minutes)

1 Ask students to debrief with their garden project group to select approximately six to eight plants for a medicinal garden. Students should record their choices in their *Plant Profile Gallery Walk Student Capture Sheet* in the bottom table. Allow students to plan a garden that may support a cross section of various health needs, or allow them to plan a themed garden based on suggestions such as (but not limited to):

- A community health issue (a collection of plants to help with asthma, for example).
- A particular body system (digestive function and health, respiratory function and health).
- Mental health or anxiety.
- Seasonal cold and flu needs.
- Pain management.
- Regionally native plants.

2 Ask students to complete the Potential User column in the bottom table of the *Plant Profile Gallery Walk Student Capture Sheet*. Prompt them to consider the following descriptors without researching them. Explain that this is intended to just introduce the idea of a *patient profile*, which is something they will be creating as part of their final project.

- Age
- Gender
- Region
- Geographic ancestry
- Risk factor group (such as individuals with diabetes, heart disease, asthma)

Small Group (15 minutes)

Allow students access to the plant profile slides created by their classmates. Ask them to begin filling out the *Medicinal Community Garden Design Capture Sheet*. Give students the option of creating their own bed design. Simply note areas that would need shade or different soil drainage. Students may opt to show different beds for different light, water, and soil needs. A pencil-and-paper plan is quick and sufficient. Students may also use a dry erase board. If available, students may prefer to use an electronic tool such as Tinkercad to create and edit their design.

Teacher Note > *As a possible extension, depending on campus space and grounds, students may be able to design their garden plan for their school community and potentially create an actual medicinal garden.*

Day 5

Procedure

LEARNING OUTCOMES

Students will be able to:

Explore the garden designs of their peers for ideas and possible future collaboration.

Evaluate peers' garden plans through the lens of positive feedback.

Practice feedback construction for future formal assessment.

Teacher Note > *During this day, students will present their garden designs. As an optional extension, consider inviting outside individuals as audience members who may have an interest in plant medicines to enrich the student experience.*

Small Group (20 minutes)

Prompt students to continue and complete their *Medicinal Community Garden Design Capture Sheet* and prepare to briefly present their designs. Potential audience members include classmates and other individuals in their community who might be interested in using the whole plant medicines that would come from their garden. Students who create a digital plan must have access to computers.

Whole Group (20 minutes)

Allow students time to explore the progress and plans of other groups' garden plans and provide "Kind, Specific, and Helpful" feedback.

Whole Group (5 minutes)

1 Allow students to look at each other's garden plans and provide feedback using sticky notes. Feedback should be "Kind, Specific, and Helpful". On sticky notes, prompt students to note:

- Specific elements they find interesting, helpful, unique, or other positives.
- Specific elements they have questions about in order to better understand the use of a particular plant or element of the garden design.
- Specific suggestions for improving clarity of ideas, organization, or further developing an idea.

2 Students can leave sticky notes on each other's garden design to model a quick version of peer feedback that they will be engaging in more formally during future lessons.

Teacher Note > *As an exit ticket (if time permits) or as homework, students should add to their **Student Guide** by completing the final question for Lesson 4.*

National Standards

Next Generation Science Standards

LS2.A Interdependent Relationships in Ecosystems
Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.

LS2.C Ecosystems Dynamics, Functioning, and Resilience
A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.

LS4.D Biodiversity and Humans
Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.

ETS1-2 Engineering Design
Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

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National Standards

Next Generation Science Standards *Continued*	**Science and Engineering Practices** Using Mathematics and Computational Thinking Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.
Career and Technical Education (CTE)	**A5.1** Use the Internet and World Wide Web to collect and share scientific information.
	A9.4 Cite examples of plant parts or extracts used as pharmaceuticals.
	A9.5 Use the Internet to find information about traditional pharmaceuticals, herbal remedies, and recombinant pharmaceuticals.
	2.5 Communicate information and ideas effectively to multiple audiences using a variety of media and formats.

Educator Resources

TEK Article Excerpts

Highlighted and Annotated

	Abstract and Introduction	Source: Raymond Pierotti and Daniel Wildcat, *Traditional Ecological Knowledge: The Third Alternative* (Commentary). Ecological Applications, Vol. 10, No. 5 (Oct., 2000)
1	Contemporary Western attitudes concerning the management of natural resources, treatment of nonhuman animals, and the natural world emerge from traditions derived from Western European philosophy, i.e., they assume that humans are autonomous from, and in control of, the natural world. A different approach is presented by Traditional Ecological Knowledge (TEK) of indigenous peoples of North America. Although spiritually oriented, TEK converges on Western scientific approaches. TEK is based on close observation of nature and natural phenomena; however, it is combined with a concept of community membership that differs from that of Western political and social thought. TEK is strongly tied to specific physical localities; therefore, all aspects of the physical space can be considered part of the community, including animals, plants, and landforms. As a consequence, native worldviews can be considered to be spatially oriented, in contrast to the temporal orientation of Western political and historical thought.	Western: separate from nature and in control of it Indigenous: part of community of nature, tied to physical environment, worldview is spatial
2	TEK also emphasizes the idea that individual plants and animals exist on their own terms. This sense of place and concern for individuals leads to two basic TEK concepts: (1) all things are connected, which is conceptually related to Western community ecology, and (2) all things are related, which changes the emphasis from the human to the ecological community as the focus of theories concerning nature. Connectedness and relatedness are involved in the clan systems of many indigenous peoples, where nonhuman organisms are recognized as relatives whom the humans are obliged to treat with respect and honor.	TEK: all things connected and related, nonhuman entities deeply respected as individuals
3	Convergence of TEK and Western science suggests that there may be areas in which TEK can contribute insights, or possibly even new concepts, to Western science. TEK is inherently multidisciplinary in that it links the human and the nonhuman, and is the basis not only for indigenous concepts of nature, but also for concepts of indigenous politics and ethics. This multidisciplinary aspect suggests that TEK may be useful in resolving conflicts involving a variety of stakeholders and interest groups in controversies over natural resource use, animal rights, and conservation.	Multidisciplinary approach of TEK can help problem solve across different stakeholders.
4	The connections that are a crucial aspect of TEK are based on a mixture of extraction, e.g., animals are taken as prey, combined with recognition of the inherent value and good of nonhuman lives (sensu Taylor 1992). Traditional knowledge is based on the premise that humans should not view themselves as responsible for nature, i.e., we are not stewards of the natural world, but instead that we are a part of that world, no greater than any other part (Pierotti and Wildcat 1997b). In this way TEK deals largely with motivating humans to show respect for nonhumans. The respect for the nonhuman inherent in TEK can constrain natural human tendencies towards overexploitation, because nonhumans are incorporated into the ritual representation of the community, and are considered as members of the community (Anderson 1996, Barsh 1997, Salmon 2000).	All entities are of equal value, respecting nonhumans will help prevent overuse and overexploitation.

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Educator Resources

TEK Article Excerpts

Highlighted and Annotated

Continued

	Space, Time and Traditional Knowledge	Source: Raymond Pierotti and Daniel Wildcat, *Traditional Ecological Knowledge: The Third Alternative* (Commentary). Ecological Applications, Vol. 10, No. 5 (Oct., 2000)
5	In recent years there has been considerable discussion of differences between the worldviews and knowledge base of indigenous peoples, and that of the "dominant" or "Western" culture (e.g., Johannes 1989, Mander 1991, Suzuki and Knudtson 1992, Anderson 1996). One major difference between native peoples of North America and Western European immigrants to North America is that the latter look backward and forward in time to get a sense of their place in history, while native peoples look around them to get a sense of their place in history. This difference has been described as thinking temporally in the case of Western culture and as thinking spatially in the case of the native peoples (Deloria 1992). The idea of human history existing independently of local places and the natural world is foreign to the native peoples of North America, because for them their history cannot be separated from the entire geography, biology, and environment to which they belong.	Western thinking is temporal, looking backward and forward in history. Indigenous thinking is spatial, connected to all surroundings
6	We cannot and do not attempt to offer a definitive treatment of all North American indigenous worldviews. The influence of local places upon cultures, and the corresponding diversity of peoples attached to those places, guarantees the existence of variation in the ceremonial and symbolic expressions of native worldviews. Our experience and research suggest, however, that there may exist a shared way of thinking and concept of community common to native peoples of North America, which we define as TEK (see also Anderson 1996). Despite both forced and voluntary relocations, native people have taken their TEK with them, which has allowed them to survive these experiences, and establish sacred places in their new homes (Owens 1998:164). This way of thought includes: (1) respect for nonhuman entities as individuals, (2) the existence of bonds between humans and nonhumans, including incorporation of nonhumans into ethical codes of behavior, (3) the importance of local places, and (4) the recognition of humans as part of the ecological system, rather than as separate from and defining the existence of that system.	Not all Indigenous communities have same worldview, but TEK is a shared way of thinking emphasizing: — respect for nonhuman entities — bonds between human and nonhuman — importance of place — humans are part of the ecosystem
7	In essence, TEK requires one to be native to a place (see also Jackson 1994), and to live with nature (see also Wilson 1992), in contrast to the dominant Western worldview, which assumes humans live above, separated, or in opposition to nature (Mander 1991, Suzuki and Knudtson 1992, Anderson 1996). To live with the geography and biology of your environment without trying to alter it solely to meet human needs is our concept of what it means to be native to a place. TEK is expressed in the ability to experience a sense of place while casting off the modern Western view that "space" exists to be conquered.	TEK view : living with nature helps conserve species and resources Western view: humans separate from nature, can conquer it
8	The origins of TEK are based on the knowledge that native societies existed under conditions of constant pressure on the resources upon which they depended, and that a means had to be found to convince communities and families to economize with regard to their use of natural resources (Anderson 1996).	
9	In TEK, we suggest that religion embodies environmental knowledge; therefore, it is not surprising that TEK is based on and has considerable insight into the workings of nature, and in many ways converges closely upon the Western science of ecology.	TEK based on knowledge of environment

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Educator Resources

TEK Article Excerpts

Highlighted and Annotated

Continued

	Traditional Knowledge and Ecological Concepts	Source: Raymond Pierotti and Daniel Wildcat, ***Traditional Ecological Knowledge: The Third Alternative*** (Commentary). Ecological Applications, Vol. 10, No. 5 (Oct., 2000)
10	The worldviews and cultures of Native American peoples evolved in the environments of the continents of North and South America. Native peoples depended upon the animals and plants of these environments for food, clothing, shelter, and companionship, and as a result developed strong ties to these nonhuman lives.	TEK view: strong ties between human and nonhuman
11	The body of knowledge acquired through careful observation came to constitute much of what Native Americans regard as TEK. One major theme of TEK is that all things are connected, which is not simply a homily or a romanticized cliche, but instead is a realization that no single organism can exist without the web of other life forms that surround it and make its existence possible. This concept is closely related conceptually to the Western discipline of community ecology, and like community ecology, it places emphasis on interrelationships between different species and individuals, and describes these interactions by employing the metaphor of a web. TEK also shares concepts based on connectedness with physiological and biochemical science related to the ecological concept of nutrient cycles (Pierotti and Wildcat 1997b). Thus, although the idea of a cycle, or circle, of life is an integral part of Native spiritual beliefs, this is not a mystical concept based upon great mysteries, but a practical recognition of the fact that all living things are literally connected to one another.	All things are connected and no organism can exist without the others in its "web." TEK connects physiological and biochemical cycles with nutrient cycles. Connections based on science
12	As a result of these connections with the nonhuman world, native peoples do not think of nature as "wilderness," but as home. Natives do not leave their "house" to "go into nature," but instead feel that when they leave their shelter and encounter nonhumans and natural physical features that they are just moving into other parts of their home (Reichel-Dolmatoff 1996).	Indigenous view of home includes all parts of the natural environment, the wilderness is not separate but part of the home community.

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Educator Resources

TEK Article Excerpts

Highlighted and Annotated

Continued

13	"What we call nature is conceived by Native peoples as an extension of biological man, and therefore a (Native) never feels 'surrounded by nature.' A (Native) walking in the forest, or paddling a canoe is not in nature, but he is entirely surrounded by cultural meanings his tradition has given to his external surroundings" (Reichel-Dolmatoff 1996:8-9). Thus, nonhuman elements are incorporated into the ritual representation of the community, establishing a nature-centered belief system (see above). At its roots, Western ecology employs a similar concept since the word "ecology" comes from "oikos," the Greek word for house, thereby acknowledging nature as the house of the human species.	Indigenous view of home includes all parts of the natural environment, the wilderness is not separate but part of the home community.
14	Within TEK the shared ideas of connectedness and nature as home have profound implications for native conceptions of politics and ethics. Unlike dominant Western political and ethical paradigms, which find knowledge of how human beings ought to act imbedded in the life of one's social, i.e., human, relationships, native peoples found within TEK instructions concerning how a person should behave as a member of a community consisting of many nonhuman persons, e.g., four-leggeds, winged-ones, plants, and even landforms (Deloria 1990, 1992, Pierotti and Wildcat 1997b).	Western ethics focus on how humans interact with humans, TEK ethics center on how to act in a community of human and nonhuman entities.
15	The relationships of native peoples to nature have often been described in terms like "harmony with nature." Such descriptions project a rather amorphous, sentimental, and romanticized character to this relationship, but overlook the empirical knowledge of the lives of plants and animals that was such a major component of the daily lives of native peoples. The attitudes and relationships of native people to other organisms result from having evolved as distinct cultures in strong association with those other creatures, and experiencing them on a daily basis.	TEK based on observed evidence, not romanticized beliefs.
16	One aspect of TEK often unrecognized is the emphasis that not only are humans dependent upon the nonhuman, but also that the reverse is often true. Activities of humans are often important in shaping the lives and ecology of the nonhuman. TEK and its emphasis on connectedness between organisms can reveal connections between species unknown to, or unrecognized by ecologists.	Humans have important impact on the ecology of nonhuman entities.

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Educator Resources

TEK Article Excerpts

Highlighted and Annotated

Continued

	Conclusions	Source: Raymond Pierotti and Daniel Wildcat, ***Traditional Ecological Knowledge: The Third Alternative*** (Commentary). Ecological Applications, Vol. 10, No. 5 (Oct., 2000)
17	TEK is a constantly evolving way of thinking about the world. Although views covered by TEK are described as "traditional," this should not be taken to mean that they cannot change. The essence of traditional beliefs is that they have existed long enough for long-range consequences to affect them (Anderson 1996). Use of the term traditional implies the repetition of a fixed body of data. Each generation, however, makes observations, compares their experiences with what they have been taught, and conducts experiments to test the reliability of their knowledge (Barsh 1997). TEK is linked to long-range consequences of human action and environmental change; therefore adherents to TEK should always be able to modify their activities and responses if environmental conditions so demand.	TEK beliefs continually change in response to observations about how the word is changing.
18	This reliance on new information as local conditions change reinforces the spatial orientation of TEK, in contrast to the temporal orientation of Western ethical systems (Deloria 1992). The spatial orientation of native peoples leads them to recognize that there are always new experiences and knowledge in the world, and transmission of TEK by oral traditions allows them to adjust in response to changing conditions. As a result, ethical and moral instructions for living are fit to the current ecological and historical context. In contrast, Western ethical behavior is derived from unchanging ideas (written words) that are thousands of years old, e.g., ancient Greek philosophers, the Bible, or the Koran. While these concepts may have been of crucial importance when they were first written down, they may be of little relevance to current ecological and social conditions. TEK derives from the physical, biological, and spiritual environment that is part of daily life (Deloria 1992), and the knowledge and experience gained through daily interaction with that environment.	Spatial orientation helps TEK thinking evolve and effectively respond to environmental changes.
19	What will be gained by placing TEK-based worldviews into a broad-based system of knowledge is the ability to access a large amount of information and experience that has been previously ignored, or treated as mysticism. This additional knowledge, with its empirically derived emphasis on the natural world, can provide us with scientifically testable insights into some of the most pressing problems facing humankind today. The multidisciplinary structure inherent in TEK should make it relatively easy for knowledge and insights gained through TEK to be communicated among members of different disciplines, leading various stakeholders to negotiate more effectively with one another through a shared conceptual framework.	TEK provides a large body of information based on observed evidence that supports different stakeholders when negotiating (collaborating and problem solving).

Tending Nature Capture Sheet

ANSWER KEY **Do not share with students**

Directions
Answer the questions below based on the Tending Nature Reading.

1. How does the resource compare and contrast use of medicinal plants as a preventive health practice compared to "allopathic" medicines?

We can live in preventive ways to reduce our need for allopathic medicines, which are medicines that treat symptoms when an individual has developed a health issue or illness.

Whole plant medicines are not a quick fix to a symptom, but a health practice from the soil up, considering all living and nonliving components of the ecosystem as part of a definition of health and medicine.

2. How is an allopathic medicine described?

Allopathic medicine focuses on reacting to disease after it arises, treating symptoms often in isolation by the body system, rather than examining the source of the disease or how the disease affects not only the individual human, but the whole ecosystem and the relationship between the human and the ecosystem.

3. Who owns or holds rights to TEK?

TEK is held as a collective property among the Chumash (and other Indigenous communities). It is a collection of deep understanding of the integrated and connected relationships among humans and other living and nonliving members of the local ecosystem. Most TEK holds are an integral part of the ecosystem.

4. Why are whole plant medicines described as health practice "from the soil up?"

Whole plant medicines have been described as health practice from the soil up because this approach relies on the health of the ecosystem to promote human health.

TEK Jigsaw Capture Sheet

ANSWER KEY **Do not share with students**

Continued

Select one:	
☒ Space, Time, and Traditional Knowledge	
☐ Traditional Knowledge and Ecological Concepts	
☐ Conclusions	
1. How do Indigenous beliefs differ from contemporary Western beliefs regarding management of the natural world and "physical space"?	Western: Look backward and forward to gain sense of place in history—temporal/time, humans live separate from nature, and that nature should be conserved (and therefore controlled) Indigenous: Look around them to get a sense of place in history—spatial thinking, connects individuals to their environment as a part of it, nature should not be controlled by any one organism. TEK is based on the workings of nature and understanding that resource depletion and extinction are threats, and is very similar to Western ecological sciences.
2. What is meant by the basic TEK concepts of "All things are related" and "All things are connected"?	Humans do not exist independent of location and environment; they are a part of it.
3. What are some key beliefs held in TEK ways of thinking?	Indigenous groups do not share all the same beliefs but TEK is a shared way of thinking (a shared intellectual property). Non-human entities are respected as individuals. Bonds between humans and non-humans include ethical codes of behavior for both. The local environment is valued, and humans are part of the ecological system in which they live as opposed to separate from it.

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TEK Jigsaw Capture Sheet

ANSWER KEY **Do not share with students**

Continued

Select one:

- ☐ Space, Time, and Traditional Knowledge
- ☒ Traditional Knowledge and Ecological Concepts
- ☐ Conclusions

1. How do Indigenous beliefs differ from contemporary Western beliefs regarding management of the natural world and "physical space"?	Western: Community ecology emphasizes interrelationships among species in an ecosystem (ecology comes from "oikos", Greek for house). Politics and ethics often focus on relationships among humans. Humans evolved from non-human ancestors. Indigenous: Dependence on plants and animals for food, clothing, shelter, and companionship developed deep ties to and respect for non-human organisms. Politics and ethics include relationships between human and non-human organisms. Non-human organisms existed long before humans evolved from them. Non-human and human organisms are related.
2. What is meant by the basic TEK concepts of "All things are related" and "All things are connected"?	No single organism can exist without the other life forms in its ecosystem that make its life possible. Similar to Western community ecology, TEK integrates biology and chemistry of nutrient cycles into beliefs on interconnectedness. Value of non-human organisms and objects is deeply recognized.
3. What are some key beliefs held in TEK ways of thinking?	Nature is not seen as wilderness, but as home, and when in nature you are always home. Your environment is an extension of your home and all objects in it have cultural meaning. TEK provides understanding about relationship dynamics among organisms that helps Western science better recognize connections.

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TEK Jigsaw Capture Sheet

ANSWER KEY **Do not share with students**

Continued

Select one:

- ☐ Space, Time, and Traditional Knowledge
- ☐ Traditional Knowledge and Ecological Concepts
- ☒ Conclusions

1. How do Indigenous beliefs differ from contemporary Western beliefs regarding management of the natural world and "physical space"?	Western: Ethics and behaviors tend to be rooted in historic ideas. Indigenous: Spatial thinking of TEK requires flexibility in ethics and behaviors as the environment changes over time.
2. What is meant by the basic TEK concepts of "All things are related" and "All things are connected"?	Multidisciplinary nature of TEK makes it easier to communicate knowledge and insights across different disciplines and stakeholder groups using a shared conceptual framework.
3. What are some key beliefs held in TEK ways of thinking?	TEK constantly evolves and changes as organisms and environments change over time, despite being generally referred to as traditional. TEK provides scientifically testable insights and knowledge, and is not simply mysticism.

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TEK Jigsaw Capture Sheet

ANSWER KEY **Do not share with students**

Continued

4. Jigsaw Share-out: Use this space to record any new key ideas from your group. Include one to two key takeaways from the article's other sections.	Answers will vary.
5. As a group, discuss and answer: How can TEK and Western science work collaboratively to improve approaches to problem solving and understanding natural phenomena?	TEK and Western ecological sciences share beliefs in the interrelatedness of species. TEK deepens that understanding by emphasizing human and non-human relationships having equal importance. TEK understanding of non-human relationships can help others see connections they may not have been aware of. The flexibility of TEK and the understanding of the effects of change over thousands of years of time in the biology and chemistry of organisms and their environment will complement Western science's efforts to understand current changes. TEK does not advocate for a mystical-based love of nature, but instead a sustainable framework for living as a part of the natural world based on respect for human and non-human organisms alike.

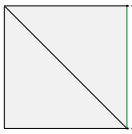
Medicinal Community Garden Design Capture Sheet

ANSWER KEY **Do not share with students**

Directions

Use the grid below to envision your garden layout. Your garden can take any shape or form that you wish. This format is a simple suggestion. Your layout may change based on the number of beds needed, location in sun or shade, and plants with varying water and drainage needs.

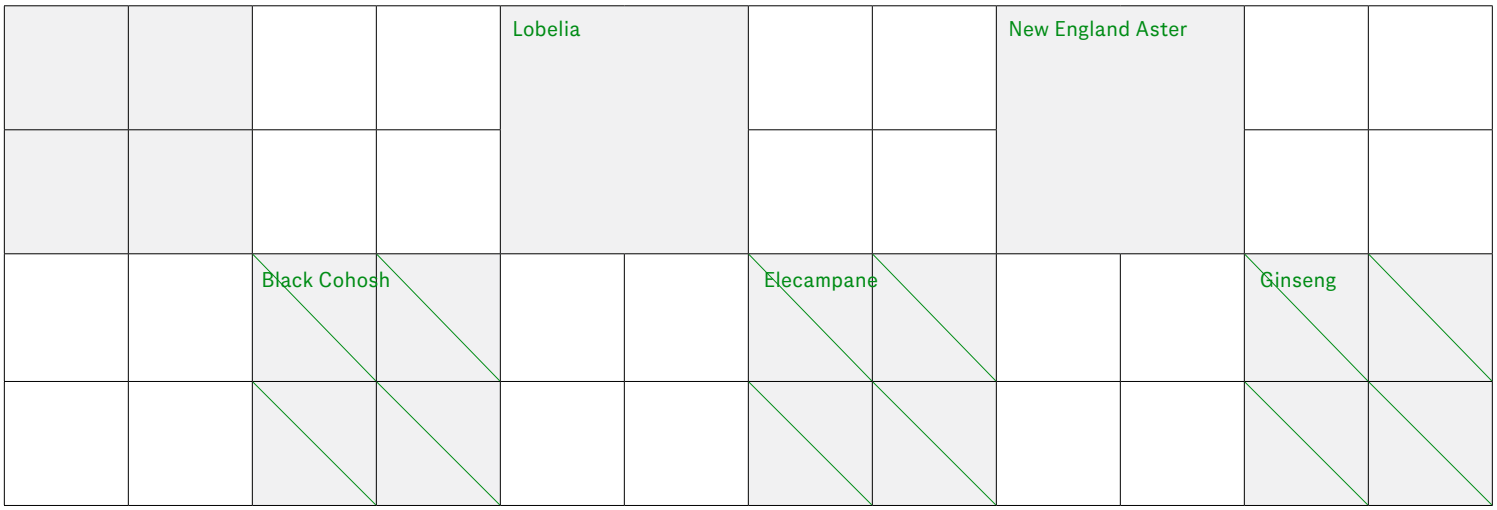
The sample below is 4" x 12". Shaded areas could suggest spacing but can vary greatly based on plant type and size.



Diagonal lines could be used to suggest bed areas that will be covered to provide shade.

Student answers will vary. Below is an example.

1. Layout your garden using the grid below.



Plants grown separately.

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Medicinal Community Garden Design Capture Sheet

ANSWER KEY **Do not share with students**

Continued

2. Describe your medicinal garden. Does it support a general variety of health needs or does it focus on a particular body system, ailment, or personal/community health need?

Our garden focuses on helping people manage asthma. The plants we chose include those with antispasmodic properties and anti-inflammatory properties that help relieve tight or constricted airway muscles and congestion. Many students at school struggle with asthma, and this garden could produce helpful plant medicines for them. People who live in heavily industrial and urban regions also suffer from asthma due to pollution, as well as people in agricultural areas where there can be a lot of particles in the air. (Source: American Lung Association's *Asthma Risk Factors* and *Farm Work-Related Asthma Among US Primary Farm Operators*.)

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Medicinal Community Garden Design Capture Sheet

ANSWER KEY **Do not share with students**

Continued

3. Create a list of the plant species used in your design, their health uses and any additional relevant informtion.

Plant species	Health use and recommendations	Additional information soil, annual or perennial, toxicity, sun or shade, size, etc.
Black cohosh	Antispasmodic	Part shade but can tolerate full sun, well-drained soil, correct dosage important for safety
Lobelia	Antispasmodic, opens airways	Full sun, well-drained soil, correct dosage important for safety
New England Aster	Helps relieve muscle constriction around airways	Full sun, correct dosage important for safety
Elecampane	Helps with congestion	Part shade but can tolerate full sun, well-drained soil, correct dosage important for safety
Hawthorn	Has flavonoids to help with inflammation	Full sun, well-drained soil, correct dosage important for safety
Ginseng	Anti-inflammatory	Needs some shade, well-drained soil, correct dosage important for safety

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Medicinal Community Garden Design Capture Sheet

ANSWER KEY **Do not share with students**

Continued

4. Share your garden design with a family or community member. Record their feedback including positives, suggestions for further development, and suggestions about other individuals who might benefit from this community health resource.

An example of a student answer is given below.

Interviewee	Positives	Suggestions
Mom	My mom liked the color scheme—she pointed out that both aster and lobelia have purple flowers!	My mom suggested that we create a guide book with clear instructions for how to use each plant as medicine. She also suggested that we think about adding a structure to the garden bed that could provide some shade, such as a knitted mesh shade tarp, because our region receives a lot of direct sunlight.
Uncle	My uncle works at an elementary school near a congested highway. He thought a garden like this would be valuable for the students there to take care of and also provide resources to support asthma. He said many students have inhalers and when it is hazy and there is a lot of air pollution, those students have to stay inside.	We would need to talk to the principal and other parents before putting this plan in place. He suggested that lower garden beds might be more assessable for smaller children to monitor and maintain.

Plant Profile Gallery Walk Student Capture Sheet

ANSWER KEY **Do not share with students**

Directions

Record potential plants of interestfor your medicinal community garden. You will share this with your group to help make decisions about plants for your garden plan.

1. Fill the table with specific information about plant of interest.

	Plant species		
	Example: Gingko biloba	Black cohosh	Lobelia
Bioactive Compound	Various flavonoids and terpenoids *Ginkgo biloba (PDF)*	Triterpene glycosides Phenolic acids	Alkaloids
Health Benefits	Used for neurological and cardiovascular disorders	Antispasmodic	Antispasmodic, opens airways
Growing Needs	Full sun Average water needs	Part shade but can tolerate full sun well-drained soil, correct dosage important for safety	Full sun, well-drained soil, correct dosage important for safety
Potential User	Individual with memory issues or symptoms related to dementia or Alzheimer's	Individuals with asthma or allergy symptoms	Individuals with asthma or allergy symptoms

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Plant Profile Gallery Walk Student Capture Sheet

ANSWER KEY **Do not share with students**

Continued

	Plant species			
	New England aster	Elecampane	Hawthorn	Ginseng
Bioactive Compound	Chlorogenic acid	Alantolactone	Flavonoids	Ginsenoside compounds
Health Benefits	Helps relieve muscle constriction around airways	Helps with congestion	Helps with inflammation	Anti-inflammatory
Growing Needs	Full sun, correct dosage important for safety	Part shade but can tolerate full sun, well-drained soil, correct dosage important for safety	Full sun, well-drained soil, correct dosage important for safety	Needs some shade, well-drained soil, correct dosage important for safety
Potential User	Individuals with asthma or allergy symptoms	Individuals with asthma or allergy symptoms	Individuals with asthma or allergy symptoms	Individuals with asthma or allergy symptoms

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Plant Profile Gallery Walk Student Capture Sheet

ANSWER KEY **Do not share with students**

Continued

2. In the table on the following page, record six to eight different plants that your group is interested in selecting for your garden plan and who the potential user could be. Your user would be someone who would benefit from whole plant medicines made from species in your garden. If you have a garden focused on a specific body system or disorder, your users might be of a certain:

— Age
— Gender
— Region
— Geographic ancestry
— Risk factor group (such as individuals with diabetes, heart disease, or asthma)

Note: If you are focusing on a specific body system or disorder, it is okay to have fewer plants in your garden based on the available plant profiles generated in class.

	Plant species	Potential User
1	Black cohosh	— Individuals who suffer from asthma symptoms such as congestion,airway constriction, spasms, and inflammation — Communities with less access to medicine and resources — Diverse communities where asthma may be more prevalent
2	Lobelia	
3	New England Aster	
4	Elecampane	
5	Hawthorn	
6	Ginseng	
7		
8		

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Tending Nature Reading

Directions

Read this example of an Indigenous use of plant medicine, and then complete the related questions.

Sources: *Tending Nature—Holistic Healing with the Syuxtun Collective*; *The Syuxtun Collective: Restoring Reciprocity With Health & Nature*

Allopathic medicines are legally sanctioned mass-produced drugs and practices used to treat symptoms or when anindividual develops a health issue or illness. Allopathic medicine often treats disease after it arises, treating symptoms often in isolation of the body system. Western medicine has perpetuated and encouraged consumers to rely on allopathic medicine through the consumption of drugs in an effort to heal and treat disease, but there are other health practices that can be used instead. Whole plant medicine serves as an alternative to allopathic medicine, considering all living and nonliving components of an ecosystem as part of a definition of health and medicine. In 2016 Julie Cordero-Lamb, an herbalist and ethnobotanist from the Coastal Band of the Chumash Nation, formed the Syuxtun Plant Medicine Collective to teach the youth about plant knowledge and stewardship. The Syuxtun Collective is named after the original village that Santa Barbara is based in. The word 'syuxtun' means 'it forks' and signifies the crucial fork in the road between the health of our individual, dynamic ecosystems and that of the Earth's. Indigenous traditions of tending the land in a dynamic relationship with our natural environment have been lost from colonialism. It is the goal of the Syuxtun Collective to not only teach lost Indigenous knowledge, but to explore our role as a dynamic member of an ecosystem.

Whole plant medicine relies on examining the source of disease or how the disease affects not only the individual human, but the whole ecosystem and the relationship between the human and the ecosystem. The traditional ecological knowledge, TEK, is held by the Chumash Nation and other Indigenous communities. The TEK is a collection of knowledge of the relationships among humans and other living and nonliving members of the local ecosystem. The TEK focuses on embracing preventative whole body options, which start with a healthy mind, body, and spirit. These concepts have been practiced by Indigenous communities like the Chumash Nation for thousands of years. Most TEK are an integral part of the ecosystem and medicinal plant knowledge has influenced our pharmacopeia. Whole plant medicines have been described as health practices from the soil up because this approach relies on the health of the plants and the ecosystem they inhabit to promote human health. Yet, whole plant medicine does not just confer a benefit to humans. Whole plant medicine establishes a relationship that interconnects humans to microorganisms, plants, and animals to their ecosystem to confer a benefit for all.

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Tending Nature Capture Sheet

Directions

Answer the questions below based on the Tending Nature Reading.

1. How does the resource compare and contrast use of medicinal plants as a preventive health practice compared to "allopathic" medicines?

2. How is an allopathic medicine described?

3. Who owns or holds rights to TEK?

4. Why are whole plant medicines described as health practice "from the soil up?"

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TEK Article Excerpts

Directions

These pages are excerpts from Traditional Ecological Knowledge (TEK): The Third Alternative commentary. After reviewing your assigned section, share the information with your group.

Abstract and Introduction

Source: Raymond Pierotti and Daniel Wildcat, ***Traditional Ecological Knowledge: The Third Alternative*** (Commentary). Ecological Applications, Vol. 10, No. 5 (Oct., 2000)

Annotations (optional)

Contemporary Western attitudes concerning the management of natural resources, treatment of nonhuman animals, and the natural world emerge from traditions derived from Western European philosophy, i.e., they assume that humans are autonomous from, and in control of, the natural world. A different approach is presented by Traditional Ecological Knowledge (TEK) of indigenous peoples of North America. Although spiritually oriented, TEK converges on Western scientific approaches. TEK is based on close observation of nature and natural phenomena; however, it is combined with a concept of community membership that differs from that of Western political and social thought. TEK is strongly tied to specific physical localities; therefore, all aspects of the physical space can be considered part of the community, including animals, plants, and landforms. As a consequence, native worldviews can be considered to be spatially oriented, in contrast to the temporal orientation of Western political and historical thought.

TEK also emphasizes the idea that individual plants and animals exist on their own terms. This sense of place and concern for individuals leads to two basic TEK concepts: (1) all things are connected, which is conceptually related to Western community ecology, and (2) all things are related, which changes the emphasis from the human to the ecological community as the focus of theories concerning nature. Connectedness and relatedness are involved in the clan systems of many indigenous peoples, where nonhuman organisms are recognized as relatives whom the humans are obliged to treat with respect and honor.

Convergence of TEK and Western science suggests that there may be areas in which TEK can contribute insights, or possibly even new concepts, to Western science. TEK is inherently multidisciplinary in that it links the human and the nonhuman, and is the basis not only for indigenous concepts of nature, but also for concepts of indigenous politics and ethics. This multidisciplinary aspect suggests that TEK may be useful in resolving conflicts involving a variety of stakeholders and interest groups in controversies over natural resource use, animal rights, and conservation.

The connections that are a crucial aspect of TEK are based on a mixture of extraction, e.g., animals are taken as prey, combined with recognition of the inherent value and good of nonhuman lives (sensu Taylor 1992). Traditional knowledge is based on the premise that humans should not view themselves as responsible for nature, i.e., we are not stewards of the natural world, but instead that we are a part of that world, no greater than any other part (Pierotti and Wildcat 1997b). In this way TEK deals largely with motivating humans to show respect for nonhumans. The respect for the nonhuman inherent in TEK can constrain natural human tendencies towards overexploitation, because nonhumans are incorporated into the ritual representation of the community, and are considered as members of the community (Anderson 1996, Barsh 1997, Salmon 2000).

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TEK Article Excerpts

Continued

Space, Time and Traditional Knowledge

Source: Raymond Pierotti and Daniel Wildcat, *Traditional Ecological Knowledge: The Third Alternative* (Commentary). Ecological Applications, Vol. 10, No. 5 (Oct., 2000)

Annotations (optional)

In recent years there has been considerable discussion of differences between the worldviews and knowledge base of indigenous peoples, and that of the "dominant" or "Western" culture (e.g., Johannes 1989, Mander 1991, Suzuki and Knudtson 1992, Anderson 1996). One major difference between native peoples of North America and Western European immigrants to North America is that the latter look backward and forward in time to get a sense of their place in history, while native peoples look around them to get a sense of their place in history. This difference has been described as thinking temporally in the case of Western culture and as thinking spatially in the case of the native peoples (Deloria 1992). The idea of human history existing independently of local places and the natural world is foreign to the native peoples of North America, because for them their history cannot be separated from the entire geography, biology, and environment to which they belong.

We cannot and do not attempt to offer a definitive treatment of all North American indigenous worldviews. The influence of local places upon cultures, and the corresponding diversity of peoples attached to those places, guarantees the existence of variation in the ceremonial and symbolic expressions of native worldviews. Our experience and research suggest, however, that there may exist a shared way of thinking and concept of community common to native peoples of North America, which we define as TEK (see also Anderson 1996). Despite both forced and voluntary relocations, native people have taken their TEK with them, which has allowed them to survive these experiences, and establish sacred places in their new homes (Owens 1998:164). This way of thought includes: (1) respect for nonhuman entities as individuals, (2) the existence of bonds between humans and nonhumans, including incorporation of nonhumans into ethical codes of behavior, (3) the importance of local places, and (4) the recognition of humans as part of the ecological system, rather than as separate from and defining the existence of that system.

In essence, TEK requires one to be native to a place (see also Jackson 1994), and to live with nature (see also Wilson 1992), in contrast to the dominant Western worldview, which assumes humans live above, separated, or in opposition to nature (Mander 1991, Suzuki and Knudtson 1992, Anderson 1996). To live with the geography and biology of your environment without trying to alter it solely to meet human needs is our concept of what it means to be native to a place. TEK is expressed in the ability to experience a sense of place while casting off the modern Western view that "space" exists to be conquered.

The origins of TEK are based on the knowledge that native societies existed under conditions of constant pressure on the resources upon which they depended, and that a means had to be found to convince communities and families to economize with regard to their use of natural resources (Anderson 1996).

In TEK, we suggest that religion embodies environmental knowledge; therefore, it is not surprising that TEK is based on and has considerable insight into the workings of nature, and in many ways converges closely upon the Western science of ecology.

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TEK Article Excerpts

Continued

Traditional Knowledge and Ecological Concepts	Source: Raymond Pierotti and Daniel Wildcat, *Traditional Ecological Knowledge: The Third Alternative* (Commentary). Ecological Applications, Vol. 10, No. 5 (Oct., 2000)
	Annotations (optional)
The worldviews and cultures of Native American peoples evolved in the environments of the continents of North and South America. Native peoples depended upon the animals and plants of these environments for food, clothing, shelter, and companionship, and as a result developed strong ties to these nonhuman lives.	
The body of knowledge acquired through careful observation came to constitute much of what Native Americans regard as TEK. One major theme of TEK is that all things are connected, which is not simply a homily or a romanticized cliche, but instead is a realization that no single organism can exist without the web of other life forms that surround it and make its existence possible. This concept is closely related conceptually to the Western discipline of community ecology, and like community ecology, it places emphasis on interrelationships between different species and individuals, and describes these interactions by employing the metaphor of a web. TEK also shares concepts based on connectedness with physiological and biochemical science related to the ecological concept of nutrient cycles (Pierotti and Wildcat 1997b). Thus, although the idea of a cycle, or circle, of life is an integral part of Native spiritual beliefs, this is not a mystical concept based upon great mysteries, but a practical recognition of the fact that all living things are literally connected to one another.	
As a result of these connections with the nonhuman world, native peoples do not think of nature as “wilderness,” but as home. Natives do not leave their “house” to “go into nature,” but instead feel that when they leave their shelter and encounter nonhumans and natural physical features that they are just moving into other parts of their home (Reichel-Dolmatoff 1996).	

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TEK Article Excerpts

Continued

	Annotations (optional)
"What we call nature is conceived by Native peoples as an extension of biological man, and therefore a (Native) never feels 'surrounded by nature.' A (Native) walking in the forest, or paddling a canoe is not in nature, but he is entirely surrounded by cultural meanings his tradition has given to his external surroundings" (Reichel-Dolmatoff 1996:8-9). Thus, nonhuman elements are incorporated into the ritual representation of the community, establishing a nature-centered belief system (see above). At its roots, Western ecology employs a similar concept since the word "ecology" comes from "oikos," the Greek word for house, thereby acknowledging nature as the house of the human species.	
Within TEK the shared ideas of connectedness and nature as home have profound implications for native conceptions of politics and ethics. Unlike dominant Western political and ethical paradigms, which find knowledge of how human beings ought to act imbedded in the life of one's social, i.e., human, relationships, native peoples found within TEK instructions concerning how a person should behave as a member of a community consisting of many nonhuman persons, e.g., four-leggeds, winged-ones, plants, and even landforms (Deloria 1990, 1992, Pierotti and Wildcat 1997b).	
The relationships of native peoples to nature have often been described in terms like "harmony with nature." Such descriptions project a rather amorphous, sentimental, and romanticized character to this relationship, but overlook the empirical knowledge of the lives of plants and animals that was such a major component of the daily lives of native peoples. The attitudes and relationships of native people to other organisms result from having evolved as distinct cultures in strong association with those other creatures, and experiencing them on a daily basis.	
One aspect of TEK often unrecognized is the emphasis that not only are humans dependent upon the nonhuman, but also that the reverse is often true. Activities of humans are often important in shaping the lives and ecology of the nonhuman. TEK and its emphasis on connectedness between organisms can reveal connections between species unknown to, or unrecognized by ecologists.	

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TEK Article Excerpts

Continued

Conclusions

Source: Raymond Pierotti and Daniel Wildcat, ***Traditional Ecological Knowledge: The Third Alternative*** (Commentary). Ecological Applications, Vol. 10, No. 5 (Oct., 2000)

Annotations (optional)

TEK is a constantly evolving way of thinking about the world. Although views covered by TEK are described as "traditional," this should not be taken to mean that they cannot change. The essence of traditional beliefs is that they have existed long enough for long-range consequences to affect them (Anderson 1996). Use of the term traditional implies the repetition of a fixed body of data. Each generation, however, makes observations, compares their experiences with what they have been taught, and conducts experiments to test the reliability of their knowledge (Barsh 1997). TEK is linked to long-range consequences of human action and environmental change; therefore adherents to TEK should always be able to modify their activities and responses if environmental conditions so demand.

This reliance on new information as local conditions change reinforces the spatial orientation of TEK, in contrast to the temporal orientation of Western ethical systems (Deloria 1992). The spatial orientation of native peoples leads them to recognize that there are always new experiences and knowledge in the world, and transmission of TEK by oral traditions allows them to adjust in response to changing conditions. As a result, ethical and moral instructions for living are fit to the current ecological and historical context. In contrast, Western ethical behavior is derived from unchanging ideas (written words) that are thousands of years old, e.g., ancient Greek philosophers, the Bible, or the Koran. While these concepts may have been of crucial importance when they were first written down, they may be of little relevance to current ecological and social conditions. TEK derives from the physical, biological, and spiritual environment that is part of daily life (Deloria 1992), and the knowledge and experience gained through daily interaction with that environment.

What will be gained by placing TEK-based worldviews into a broad-based system of knowledge is the ability to access a large amount of information and experience that has been previously ignored, or treated as mysticism. This additional knowledge, with its empirically derived emphasis on the natural world, can provide us with scientifically testable insights into some of the most pressing problems facing humankind today. The multidisciplinary structure inherent in TEK should make it relatively easy for knowledge and insights gained through TEK to be communicated among members of different disciplines, leading various stakeholders to negotiate more effectively with one another through a shared conceptual framework.

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TEK Jigsaw Capture Sheet

Directions

Use this tool to capture key points from the Traditional Ecological Knowledge: The Third Alternative reading.

The Abstract and Introduction section are filled in to serve as a guide.

Abstract and Introduction	
1. How do Indigenous beliefs differ from contemporary Western beliefs regarding management of the natural world and "physical space"?	Western: Humans are in control of the natural world. Natural resources are valuable for human use. Nature should be protected by what humans feel is valuable Indigenous: Plants and animals exist on their own terms. Non-human organisms should not be controlled by humans, and protecting nature can be seen as controlling it.
2. What is meant by the basic TEK concepts of "All things are related" and "All things are connected"?	Humans and non-humans are linked, and non-human organisms are relatives and deserve to be respected. Humans are not responsible for nature but instead are completely connected to it, as equals.
3. What are some key beliefs held in TEK ways of thinking?	Multidisciplinary ways of linking humans and non-humans may provide new insights and concepts to Western science, and may help with problem solving conflicts or controversies among stakeholder groups regarding natural resources, conservation, and animal rights. Respect for non-human organisms will help constrain overexploitation.

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TEK Jigsaw Capture Sheet

Continued

Select one:	
☐ Space, Time, and Traditional Knowledge	
☐ Traditional Knowledge and Ecological Concepts	
☐ Conclusions	
1. How do Indigenous beliefs differ from contemporary Western beliefs regarding management of the natural world and "physical space"?	
2. What is meant by the basic TEK concepts of "All things are related" and "All things are connected"?	
3. What are some key beliefs held in TEK ways of thinking?	

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TEK Jigsaw Capture Sheet

Continued

4. Jigsaw Share-out: Use this space to record any new key ideas from your group. Include one to two key takeaways from the article's other sections.

5. As a group, discuss and answer:

   How can TEK and Western science work collaboratively to improve approaches to problem solving and understanding natural phenomena?

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Medicinal Plant Profile Capture Sheet

Directions
Select one of the plans from the Common Medicinal Plant Menu, and provide details about it by answering the following questions.

Plant Name

Paste a photo of your plant here.

1 Healing Properties

How does this plant promote health and healing?

2 Indigenous TEK Connections

How has this plant been used by Indigenous groups (which groups, medicinal application, etc.)?

3 Pharmaceutical Use

What information about the plant's medicinal properties is known (bioactive compound, dosage or toxicity, etc.)?

4 Cultivation

Where does the plant grow?

What are the optimal soil, lighting and watering conditions for the plant?

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Common Medicinal Plant Menu

Directions

This table suggests some commonly known plants and potential documented applications for those plants. This table is only a sampling of medicinal plants; many more medicinal plants have been used to treat a wide range of health ailments. Review the plants list along with their potential applications and the plant part used. Select a few plants for your medicinal garden.

Plant	Potential Applications	Plant Part
Aloe	Burns, swelling, redness, pain relief	Leaves
Calendula	Skin irritations, burns, rash, wound healing, digestive anti-inflammatory, GERD, ulcer relief	Flowers
Chamomile	Gastrointestinal disturbances, anxiety, inflammation	Flowers
Cinnamon	Antioxidant, anti-inflammatory, antimicrobial, potential activities against neurological disorders	Bark
Dandelion	Liver, kidney, and digestion support	Leaves, root
Echinacea	Cold, flu, infections, wound healing	Leaves, stalk, root
Feverfew	Migraine, fever	Leaves
Foxglove	Cardiac stimulating properties (high toxicity)	Leaves
Garlic	Bacterial, viral, fungal, and parasitic infections, immune health, antitumor and antioxidant	Clove
Ginger	Nausea, potential anti-cancer properties	Root
Ginseng	Energy, stress maintenance	Root
Goldenseal	Antiseptic, skin irritations, diarrhea	Root, rhizome
Hyssop	Intestinal inflammation, coughs, bronchitis and respiratory infections, sore throat, asthma, urinary tract infection, flatulence and colic, sedative effects, skin irritation	Flower tops, leaves
Lavender	Stress, high blood pressure, eczema, psoriasis	Flowers

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Common Medicinal Plant Menu

Continued

Plant	Potential Applications	Plant Part
Lemon balm	Insomnia, stomach ailments, anxiety, herpes sores	Leaves
Lupine	Nausea, hemorrhaging	Leaves
Milk thistle	Liver conditions, high cholesterol, potential anti-cancer properties	Fruit
Nettle	Allergies, enlarged prostate, joint pain, blood sugar control, high blood pressure	Leaves
Oregano	Antibacterial, antifungal, antiparasitic, respiratory conditions	Leaves
Peppermint	Antiseptic, GI issues, tension, headache	Leaves
Rosemary	Disinfectant, headaches, fever, circulation trouble	Leaves and oil
Skullcap	Insomnia, depression, fever, high blood pressure, tension	Roots and leaves
St. John's wort	Antidepressant, GI problems	Flower, leaves
Thyme	Antiseptic, antifungal, antiparasitic, cough, bronchitis	Flowers, leaves and oil
Tulsi	Antimicrobial, cold, cough, asthma, bronchitis, sinusitis, headache	Leaves and flowers
Turmeric	Anti-inflammatory, potential anti-cancer properties, skin diseases	Root
Valerian	Insomnia, anxiety	Root
Yarrow	Wounds, cuts, abrasion, bruising	Flowers and leaves

Sources

University of Rochester Medical Center's *A Guide to Common Medicinal Herbs*, Traditional Medicinals' *Tulsi 101*, Indiana Medical History Museum's *Guide to the Medicinal Plant Garden*, National Library of Medicine's *List of Herbs in the NLM Herb Garden*, and Rain-Tree Publishers' *Plant Based Drugs and Medicines*.

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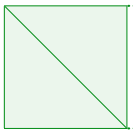
Medicinal Community Garden Design Capture Sheet

Directions

Use the grid below to envision your garden layout. Your garden can take any shape or form that you wish. This format is a simple suggestion. Your layout may change based on the number of beds needed, location in sun or shade, and plants with varying water and drainage needs.

The sample below is 4" x 12". Shaded areas could suggest spacing but can vary greatly based on plant type and size.



Diagonal lines could be used to suggest bed areas that will be covered to provide shade.

1. Layout your garden using the grid below.

Plants grown separately.

Continues next page >

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Medicinal Community Garden Design Capture Sheet

Continued

2. Describe your medicinal garden. Does it support a general variety of health needs or does it focus on a particular body system, ailment, or personal/community health need?

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Medicinal Community Garden Design Capture Sheet

Continued

3. Create a list of the plant species used in your design, their health uses and any additional relevant informtion.

Plant species	Health use and recommendations	Additional information soil, annual or perennial, toxicity, sun or shade, size, etc.

Continues next page >

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Medicinal Community Garden Design Capture Sheet

Continued

4. Share your garden design with a family or community member. Record their feedback including positives, suggestions for further development, and suggestions about other individuals who might benefit from this community health resource.

Interviewee	Positives	Suggestions

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Plant Profile Gallery Walk Student Capture Sheet

Directions

Record potential plants of interest for your medicinal community garden. You will share this with your group to help make decisions about plants for your garden plan.

1. Fill the table with specific information about plant of interest.

	Plant species		
	Example: Gingko biloba		
Bioactive Compound	Various flavonoids and terpenoids *Ginkgo biloba (PDF)*		
Health Benefits	Used for neurological and cardiovascular disorders		
Growing Needs	Full sun Average water needs		
Potential User	Individual with memory issues or symptoms related to dementia or Alzheimer's		

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Plant Profile Gallery Walk Student Capture Sheet

Continued

	Plant species	
Bioactive Compound		
Health Benefits		
Growing Needs		
Potential User		

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Plant Profile Gallery Walk Student Capture Sheet

Continued

	Plant species	
Bioactive Compound		
Health Benefits		
Growing Needs		
Potential User		

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Plant Profile Gallery Walk Student Capture Sheet

Continued

2. In the table on the following page, record six to eight different plants that your group is interested in selecting for your garden plan and who the potential user could be. Your user would be someone who would benefit from whole plant medicines made from species in your garden. If you have a garden focused on a specific body system or disorder, your users might be of a certain:

— Age
— Gender
— Region
— Geographic ancestry
— Risk factor group (such as individuals with diabetes, heart disease, or asthma)

Note: If you are focusing on a specific body system or disorder, it is okay to have fewer plants in your garden based on the available plant profiles generated in class.

	Plant species	Potential User
1		
2		
3		
4		
5		
6		
7		
8		

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Rubric for The Role of TEK in Drug Development

Using Mathematics and Computational Thinking

Observable features of the medicinal plant garden	**Meets Expectations** 8–10 points	**Progressing** 5–7 points	**No attempt** 0 points
Research and planning			
a. Students explore western and TEK values and relate them to ecology.			
b. Students research the TEK of medicinal plants.			
Prototype model			
a. Creation of a detailed garden prototype in 2-D or 3-D			
b. Connect garden design to medicinal plants and Indigenous TEK			
Gallery walk			
a. Garden design illustrates key features and the presenter is able to explain evidence provided for key features in the design.			
b. Students provide kind, helpful, and specific peer feedback to other garden designs.			
c. Students consider how the garden designs either reflect or do not reflect the values and information provided through Indigenous TEK.			
Final Score			
Grade			