

Tree Tender Curriculum Bundle

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Introduction

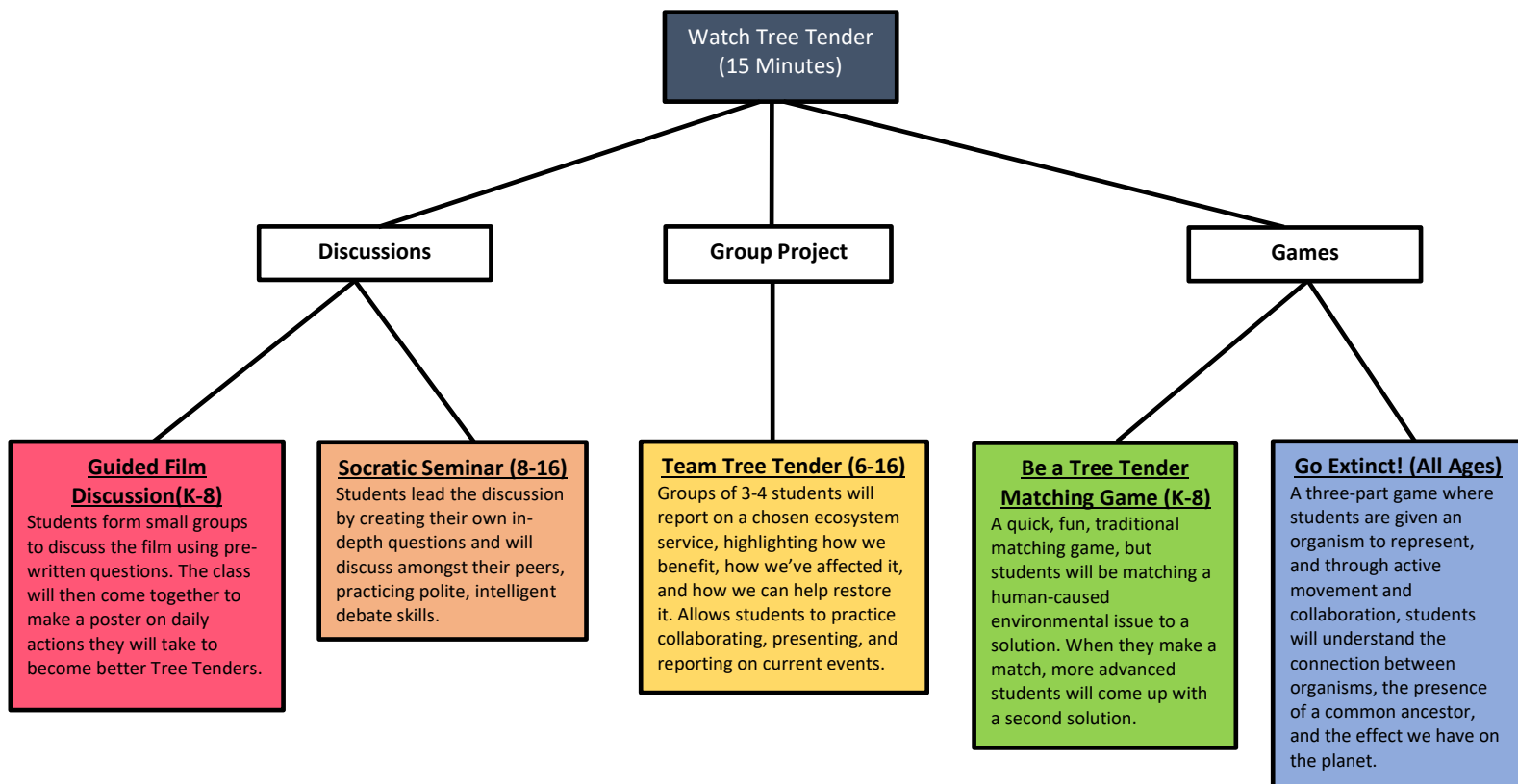
The short film Tree Tender (2016) follows a young woman, Gaia, becoming the newest Tree Tender. We see her learning about the Tree of Life, the connections between all organisms on the Tree, the importance of understanding these connections, and the human-caused mass extinction currently occurring. Each of these major concepts are highlighted in this bundle of educational resources appropriate for both K-12 and Undergraduate Education. Included are five activities for your classroom to use after watching the film that all meet the Next Generation Science Standards and the Vision and Change Standards for Higher Education so that your students can make connections and have fun while meeting many requirements and learning milestones.

While the activities have a target grade level range, all activities can be modified for any level classroom, should you want to use them for another grade level. Modifications will be on the educator's page with each activity. All materials will assist in increasing critical thinking and communication skills while connecting current events, events from the film, and scientific knowledge.

You are free to do as many of the activities as you believe your classroom needs and in any order. However, it is **recommended** that you do as many of the activities as possible. They all vary in content and skills, and performing all activities will give your students a very well-rounded education and the best possible understanding of the concepts and messages presented in Tree Tender. A full curriculum would include one of the discussions (for your target grade level), the group project, and the two games. The infographic on the next page provides an easier way to view these activities with a short summary of each project. Happy Learning!

Infographic

This activity tree is a guide to the five activities provided to help you in deciding what lessons will be most suitable for your classroom. The recommended grade level is presented along with each summary to help you make your assessment from K-12 through undergraduate education (grade level 13-16). Further information and all required materials will be provided in the pages following.



Guided Film Discussion

The Guided Film Discussion is a great activity to facilitate conversation for lower level classes (K-8), especially done immediately following the film. This discussion allows students the opportunity to connect between the film, current events, and previous concepts the students have learned. The worksheet includes five basic questions that represent the major themes of the entire film. Depending on the grade or maturity level, a full in-depth discussion could take place, if desired. This allows students to take from other disciplines or experiences to form their arguments for living a more sustainable lifestyle. Grade levels that have already discussed the concept of evolution can also discuss how the film touched on the subject when discussing how we relate to other organisms on the tree and how we use the tree to understand more.

The poster created at the end of the lesson will be a great daily reminder on how they, too, can be Tree Tenders. Regardless of age group, brainstorming on the worksheet, discussing with peers, and creating a poster for the classroom should give students of many different learning preferences a more concrete understanding of the message from the film. This uses pedagogy like Open-Ended Instruction, Experiential Learning, and Co-operative Learning to discuss ecological concepts like the Anthropocene Extinction and biodiversity loss, natural history, the use of the Tree of Life, and ecosystem services we rely on.

Abstract

In the film Tree Tender, Gaia, our protagonist and main tree tender, learns about the importance of the Tree of Life to represent the ancestry and relationships between all life that has ever existed. In better understanding these relationships, we can better assess where our attention must be directed to slow the loss of biodiversity caused by humans. Students will break into small groups to discuss what they learned from the film, how our actions affect the planet, and what we can do to become stewards to the planet.

Learning

At the end of this guided discussion, students will be able to:

- Understand the importance of the Tree of Life
- Understand ecosystem services we benefit from
- Connect the events from Tree Tender to events in their daily life
- Think critically about their actions and effects on other species and the planet
- Brainstorm with their peers on solutions to environmental problems on our planet

Timeframe and Materials

Instructor preparation should take no more than 30 minutes. Watching Tree Tender takes about 15 minutes. Guided Discussion should take about 30 minutes.

You will need:

- The Supplemental Guided Discussion Worksheet for Each Student
- Large sheet of paper or poster board
- Markers

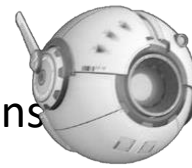
Procedures

1. Begin by asking students to review the events of the film.
2. Divide students into groups of 4-5 to brainstorm on their own for a few minutes to answer the questions on the Supplemental Worksheet, using examples from the film or what they've witnessed in their daily lives.
3. Come together as a \ class to discuss the students' answers together
4. On a large sheet of paper or poster board, write down what the students come up with to help slow the loss of biodiversity (Question #5)
5. Hang the paper where students can see and be reminded of how to be a Tree Tender!
6. **Modification for younger ages:** discuss the same questions and create a poster as a class without breaking into groups.
7. **Modification for older ages:** While the Socratic Seminar may be better suited for more critical thinking, this guided discussion is a great way to summarize the film. Have the discussion be more in-depth, and allow each group to make a poster to share in front of the class on how they will become Tree Tenders in their daily life.

Next Generation and Vision and Change Standards Met

Next Generation Science Standards (K-12):	Vision and Change (for higher education):
<ul style="list-style-type: none">-Natural Resources-Human Impacts on Earth Systems-Developing Possible Solutions-Evidence of Common Ancestry and Diversity-Biodiversity and Humans-Human Impacts on Earth Systems-Ecosystem Dynamics, Functioning, and Resilience-Global Climate Change-Influence of Science, Engineering, and Technology on Society and the Natural World	<ul style="list-style-type: none">-Systems-Tap Into the Interdisciplinary Nature of Science-Communicate and Collaborate with Other Disciplines-Understand the Relationship Between Science and Society

Tree Tender Film Questions



Name: _____

Date: _____

Directions: Answer the questions below (individually or in a small group) after watching Tree Tender. Come together as a class to discuss your answers and come up with the best way you can be a Tree Tender, too!

How are we connected to other organisms on the planet?

How can we use the Tree to better understand other organisms?

How do we benefit from ecosystem services?

How do we affect the planet and its inhabitants?

What can we do to help Gaia slow the loss of biodiversity?

Socratic Seminar

The main themes of the film are understanding what the tree of life is, how humans have both designed and benefited from it, ecosystem services, and the sixth mass extinction we are currently causing. In this Socratic Seminar, you will assign your students to write three questions they could use to facilitate discussion. Below are some guiding questions you may use as examples to help the students to develop their questions or to ask during the Socratic Seminar in between students' questions. However, you may not end up needing the guiding questions if your students write very thought-provoking questions. Some questions provided and asked by the students will be simple, while others could begin a longer conversation, but all questions appropriate to the lesson are valid. Participation is the key learning tool here. Try and have all students talk at least three times during the seminar. This uses pedagogy like Open-Ended Instruction, Experiential Learning, and Co-operative Learning to discuss ecological concepts like the Anthropocene Extinction and biodiversity loss, natural history, the use of the Tree of Life, and ecosystem services we rely on.

Abstract

In the film *Tree Tender*, Gaia learns about the importance of the Tree of Life to represent the ancestry and relationships between all life that ever existed. In better understanding these relationships, we can better assess where our attention must be directed to slow the loss of biodiversity caused by humans. Student will write their own open-ended, thought-provoking questions to facilitate discussion, taking turns to ask their questions and discuss and debate in a courteous manner. When discussing, students should use information and examples from the film, other lessons, and current events to strengthen their claim.

Learning

At the end of this Socratic circle, students will be able to:

- Create and ask thought-provoking questions to facilitate further discussion
- Answer questions using previous lessons, current events, and individual thought
- Connect moments and themes from the film to daily life and societal issues
- Improve critical thinking, speaking, and debate skills

Timeframe and Materials

Instructor preparation should take about 30 minutes. Watching *Tree Tender* takes about 15 minutes. Socratic Seminar should take the entire class period, and may be extended a 2nd class period, if desired.

You will need:

- Supplemental Socratic Seminar Instructions for Teachers
- Supplemental Socratic Seminar Instructions for each student
- Desks arranged in a circle (or outdoor seating area)

Guiding

Tree of Life Questions

1. What is the Tree of Life and how do we benefit from it?
2. How do scientists make or modify the Tree?
3. How is the Tree designed to help us better understand evolutionary history and ancestral connections?
4. How are all the taxonomic groups be related? (Use those within a single Kingdom and the Kingdoms themselves, such as Plantae and Protista)
5. Describe the endosymbiotic theory.
6. How can humans use the Tree to better understand organisms?

Ecosystem Services Questions

1. What are ecosystem services?
2. Give some examples of how humans benefit from these service.
3. How have humans destroyed ecosystem services?
4. How do you think this might affect us and other organisms in the future?

Humans and the Planet Questions

1. We are currently facing the 6th Mass Extinction. What have we done to speed up the process?
2. Some scientists believe we will soon pass the point of aiding our planet when it comes to climate change. Do you agree or disagree? Explain.
3. Predict what would happen if our population continued to grow, surpassing 10 billion people.
4. How has our society changed over the last 100 years that have increased this rate of planet abuse (ex: single use items, new technology, consumerism changes, etc.).
5. Technology changes have really changed how we function in the world, and how much energy and material is used in manufacturing new technology. What are some pros and cons to our changes in technology over the years?
6. How might wealth affect our planet carbon footprint?
7. What societal changes could help lower our carbon footprint? (Ex: redistribution of wealth, education improvement, health care).
8. List some causes of the current extinction event and discuss. Can the class agree on the biggest one?
9. Why do informed people continue living an environmentally destructive life? Are there ways you would try to influence behavior?
10. Imagine you're designing a city. What are ways you could plan for incorporating natural ecosystems, conservation, and a more environmentally friendly lifestyle into the city?
11. What do we need to do to tackle these issues at any level (home, school, city, world)?
12. What do we need to change in government to slow the loss of biodiversity?
13. What would happen if a whole level of the food chain went extinct? (Teacher: feel free to choose a level from decomposers, producers, and consumers, or have students discuss freely)
14. How can we help? What are steps we can take to hopefully make a difference?
15. If we continue as is, how might (manufacturing, energy, economy, health, etc.) change?
16. Design sustainable agriculture, technology, or disposal based on what you know

Procedures

1. Begin by asking students to review the events of the film.
2. The day before the Socratic Seminar, instruct students to create three well-written, thought provoking questions for use in the discussion (see teacher page for examples).
3. On the day of the Socratic Seminar, arrange seating area into a circle, if possible, to allow students to better connect and discuss.
4. Open the floor up to students asking their own questions first, asking for a volunteer to begin the questions.
5. Allow the students the freedom to debate and discuss the questions for a few minutes, only stepping in if the discussion gets heated.
6. As one question winds down and there is silence in the room, have students step in and ask their questions at will.
 - You may also individually choose students to ask their question if no one is voluntarily stepping in, especially students who have been quieter and have not participated.
7. Make sure all students in the class participate at least three times.
8. Have your students turn in their questions to receive full credit.
9. **Modification for younger ages:** Pair students up to help each other write questions, and have students practice asking and answering in the Socratic Seminar just as older students would.

Next Generation and Vision and Change Standards Met

Next Generation Science Standards (K-12):	Vision and Change (for higher education):
-Natural Resources -Human Impacts on Earth Systems -Developing Possible Solutions -Evidence of Common Ancestry and Diversity -Biodiversity and Humans -Human Impacts on Earth Systems -Ecosystem Dynamics, Functioning, and Resilience -Global Climate Change -Influence of Science, Engineering, and Technology on Society and the Natural World	-Systems -Tap Into the Interdisciplinary Nature of Science -Communicate and Collaborate with Other Disciplines -Understand the Relationship Between Science and Society

Tree Tender Socratic Seminar

Name: _____

Date: _____

You will be participating in a Socratic Seminar today. All students will need to participate in the discussion three times in order to earn credit. Try and use examples from the film Tree Tender and from previous lessons and current events. Remember to be courteous, and if you disagree with someone, make sure to do so respectfully. Take turns speaking, letting one person talk at a time without interruption. You do not need to raise your hand to speak, but simply jump in with your point after other students have finished their point.

You will also need to write three thought-provoking questions to facilitate the discussion. Write your questions below, keeping with the theme of the film Tree Tender (the design and use of the Tree of Life, Ecosystem Services, the balance of many organisms on the planet, and the human-caused extinction event currently happening). The more in-depth your question, the better the discussion will be, and the more opportunity for participation.

Questions:

1.

2.

3.

Use the back of the page to take notes during your discussion!

Team Tree Tender!

This project involves small groups performing in-depth research on an ecosystem service for Gaia. This project is best for students in the 6th-12th grades and in small undergraduate classes, and research is best completed over a week (or more) to create an eye-catching presentation or representation of the ecosystem service. It can be modified for younger students and for shorter time periods (a brief research period and presentation on the students' findings).

Students will present their report, allowing the entire class to get a complete look at many ecosystem services. The class will then come together and answer assessment questions, which highlight environmental issues, innovative solutions they can come up with, and life changes they can make to help. By dividing the various ecosystem services, all students will get a better idea of many ecosystem services we depend on. This presentation ties together the message from Tree Tender: that we're all connected and dependent on one another, and can make a change.

The benefit of this activity is the ability for students to collaborate and work together on tackling real-world issues, gives students an opportunity to create and present their work and hone their public speaking skills, and helps students learn what makes a source credible and how to conduct research on their own. This project may cover ecology, sustainability, and ecotourism. It uses many different pedagogy, like Open-Ended Instruction, Integrated Learning, Experiential Learning, Co-operative Learning, and Peer Teaching through the presentations.

Abstract

In the film Tree Tender, CAaLVIN discusses the ecosystem service coral reefs provide to us. There are many other services that are naturally provided to us that are crucial to our survival, and without them life would be extremely expensive or impossible for us and other species. You will split your class into groups of 3-4 students. Each group will choose an ecosystem service to research and create an eye-catching presentation. Once all students have presented their ecosystem service, the class will come together and discuss changes we can make to our daily lives to help slow biodiversity loss and the loss of these ecosystem services.

Learning

- Define Ecosystem Services and identify examples
- Perform research using credible internet sources
- Collaborate with peers to identify a problem and find a solution
- Critically think about how our actions affect the planet
- Critically think about solutions to real problems on our planet
- Create an eye-catching representation and report on an ecosystem service
- Gain skills in public speaking

Timeframe and Materials

Instructor preparation should take about 30 minutes. Watching Tree Tender takes about 15 minutes. Project should take 1-2 weeks (most work outside of class) for in-depth research and a well-made project. If time constraint occurs, project and depth of research and presentation can be altered so work takes less time.

You will need:

- Computer, Tablet, or Smart Phone with internet access
- Access to online sources or books in the library
- Presentation materials, such as posters, dioramas, art supplies, or a computer for multimedia presentations (slideshow or video)

Procedures

1. Divide students into groups of 3-4
2. Have students choose the Ecosystem Service from the list provided.
 - Concrete examples are provided here in the teacher materials. Have students try and come up with their own examples before aiding students.
 - Make sure you approve of the students' choice before they begin researching.
 - If the students need to make a change after their research has begun, they need to seek approval from the instructor before continuing.
3. Give students the week (or more, depending on class schedule) to research:
 - The Ecosystem Service in detail (what it is, our benefit, how other species benefit, etc.)
 - A specific example of their ecosystem service
 - Things we've done to disrupt the service (our impact, cost to replace service, etc.)
 - A current event or research based on their ecosystem service or example chosen
 - How we can help (individually, in our school, in our community, etc.)
4. Have the students make a presentation (PowerPoint, or creative visual aid such as a video, or physical art project) to spread the knowledge of their ecosystem service to their classmates.
 - Presentation or display must be professional, clean, and understandable enough for Gaia to check out during her busy day.
 - Presentation must be approved by the instructor to make sure it is allowed by the school and the room is prepared.
 - Presentations should last about 10 minutes per group, but feel free to modify the presentation time limit based on your class size and grade level as you see fit.
5. **Modification for Shortened Time:** If there is a time constraint, project can be altered to involve brief research within a day and a short presentation the following class period.
6. **Modification for younger ages:** this project may also be suitable for upper elementary school ages, with research performed in the classroom in case there are questions. Depth of research will reflect on the grade level, but the skills gained are important for all grade levels.

Available Ecosystem

Below are the available topics your students may choose from with explanations or examples. Try and get your students to come up with their own examples first, and use these for guidance or as a last resort. Remember to require your students to have their topics approved by you first.

Supporting Services:

Habitats for Other Species - necessities provided for migratory/residents

(Ex: Wetlands and prairies provide ample habitat for migratory birds, but are often lost to human development)

Genetic Diversity - diverse gene pool within a species/high numbers of species

(Ex: Levels of higher biodiversity show fewer diseases in ecosystems and in agriculture.

Questions your students may ask are what does a more diverse population provide?

Examples could include natural populations, such as cheetah genetic diversity or how habitat fragmentation affects woody or herbaceous plants, or in monoculture, such as with potato or corn leaf blight)

Provisioning Services:

Food - for human consumption from wild sources

(Ex: Fish populations and the issue with overfishing; aquatic and marine invertebrates, discovering new plant or animal food sources, benefits of regulated hunting; while pollination affects our food sources, keep this group from straying into that category)

Raw Materials - for construction and fuel (energy)

(Ex: wood for building or fuel, fuel from switchgrass (*Panicum virgatum*) or corn, mining for construction materials, fossil fuels and how extraction may become more difficult)

Medical Resources - medicinal plants and raw materials for manufacturing

(Ex: Humans have been using plants, such as ginger, ginkgo, and lavender, for hundreds of years; Black Willow, *Salix nigra*, used for pain; new research around traditional medicinal plants in Africa has begun in 2017 to look at secondary metabolites in these plants and how they might affect people)

Water Availability - vegetation provide purified water; hydrological cycle

(Ex: In destroying ecosystems, such as the Blackland Prairie or rainforests in South America, Asia, and Africa, we see a loss of fresh water replenishment in clouds, leading to drought conditions and a vicious cycle of drying. Grasslands lead to the purification of water above and below ground in aquifers in North America)

Regulating Services:

Air Quality – plants remove pollutants from atmosphere

(Ex: Plants store pollutants from air, sometimes with the help of fungi; NASA study on carcinogenic contaminants filtered by plants; trees improving contaminant levels, such as NO₂ in urban areas.

Carbon Sequestration - ecosystems store greenhouse gasses and can remove CO₂

(Ex: Deforestation of large wooded areas have not only released CO₂, but plants are no longer living to convert carbon dioxide to oxygen; students may want to research how much carbon dioxide scientists believe is being converted this year compared to previous years)

Erosion Control - plant cover prevents land degradation and improves soil fertility

(Ex: Madagascar has lost 90% of its plant cover, and erosion of red soils into ocean can be seen by satellites; erosion and increased run-off of soils and pollutants from cities due to loss of plant cover worldwide, leading to flooding events and pollutants in natural bodies of water)

Pollination - insect, Bird, and Bat Pollination, especially

(Ex: Recent studies on loss of bees and the cost it would take to pollinate by hand; some plants are adapted to have very specific pollinators; how would wind pollination work with fragmented habitats?)

Biological Control - regulate pests and diseases that affect all organisms by predation and increasing biodiversity

(Ex: Sharks feed on diseased or dying fish, and with the increased loss of sharks we could see our fish supply becoming more diseased; Zika outbreak due to Aedes mosquitoes, which increase with temperature and with loss of natural predators; Mountain Pine Beetle decimating the Rocky Mountain Pines; Invasive species with no natural predators, like the fungus *Cryphonectria parasitica* causing the chestnut blight in the 1900s)

Weather Extremes Control - natural hazards like landslides, hurricanes, flooding

(Ex: Mangrove forests protecting the coast from hurricanes/tsunamis, landslide increase from the loss of plant cover/roots and increased soil erosion, urban areas with increased flooding due to loss of plants)

Waste Decomposition - decompose and filter human and animal waste

(Ex: Wetlands filter animal waste, including our own waste, through plants, microorganisms, invertebrates, and fish; decomposers of human waste, such as insects and invertebrates as well as microorganisms in soil)

Culture Services:

Mental Health - role green spaces play in mental health, issue of city living on mental health

(Ex: Past studies on the importance of green spaces and green belts in city living, such as Central Park or the Green Belt in Austin, TX; Recent Studies on the benefits of plants inside apartments; Singapore Green Spaces and their benefits to humans as well as other organisms)

Eco-Tourism - biodiversity and ecosystems attract visitors, boosting local economy

(Ex: Poachers have been known to take jobs as tour guides or artisans for a higher salary How does ecotourism affect local people? What pros and cons may exist for having people travel to an area? How might snorkeling traffic affect a reef? What places or species have been protected due to ecotourism?)

Spiritual/Religious Purpose - natural features with sacred meaning

(Ex: Natural Heritage Sites like Uluru-Kata Tjuta in Australia, Sacred Groves or forests in Estonia, Kashima Wildlife Preservation Area in Japan, Osun-Osogbo Sacred Grove in Nigeria, Mount Sinai in Egypt)

Assessment

- After all the students have presented, have them come together as a class and list some of the ecosystem services on our planet.
- How have we affected these services?
- Does it only affect us? What other organisms are affected by the loss of biodiversity?
- What do you think might happen if we lose too many species and too many services?
- What is one thing you can do to help?
- What is one thing your community can do to help?

Next Generation and Vision and Change Standards Met

Next Generation Science Standards (K-12):	Vision and Change (for higher education):
<ul style="list-style-type: none">- Natural Resources-Human Impacts on Earth Systems-Developing Possible Solutions-Biodiversity and Humans-Ecosystem Dynamics, Functioning, and Resilience-Interdependent Relationships in Ecosystems-Science Addresses Questions About the Natural and Material World-Weather and Climate-Global Climate Change-Science is a Human Endeavor	<ul style="list-style-type: none">- Ability to Use Quantitative Reasoning-Tap Into the Interdisciplinary Nature of Science-Communicate and Collaborate with Other Disciplines-Understand the Relationship Between Science and Society

Team Tree Tender!

After seeing some loss of biodiversity, Gaia needs your help taking inventory on ecosystem services! These services are important for our survival and the survival of other organisms we share this planet with. In a small committee of 3-4 Tree Tenders, choose an Ecosystem Service from the list below to monitor and help Gaia. The more we understand about services and other organisms, the better we can protect them for their survival! In order to provide Gaia with enough information, we need to find out what the ecosystem service is (in general), a specific example of that ecosystem service, how we benefit from it (physically, economically, emotionally, etc.), and a recent study or event on how we've disrupted the ecosystem service. Finally, come up with a few solutions to help preserve this ecosystem service. Make sure you create a professional, eye-catching presentation to show Gaia!

Your Group Members are: _____

Your Ecosystem Service is: _____

Your Presentation is Due: _____

Ecosystem Services to Choose From

Supporting Services:

Habitats for Other Species
Genetic Diversity

Provisioning Services:

Food
Raw Materials
Medical Resources
Water Availability

Regulating Services:

Air Quality
Carbon Sequestration
Erosion Control
Pollination
Biological Control
Weather Extremes Control
Waste Decomposition

Culture Services:

Mental Health
Eco-Tourism
Spiritual/Religious Purpose

Be A Tree Tender Matching Game

Educator Materials

This short game is perfect to play in small groups, and is recommended that students play each other one-on-one (or allow students the opportunity to take cards home to play with a sibling or guardian). While the play of the game is similar to standard matching games, there is a major difference in how matches are made. Rather than matching identical cards, you will match a problem we've created on the planet to a solution we can easily do at home. These use the guidelines on our website "Becoming a Tree Tender". For younger students, key words are bolded to help with understanding. A single round of this game should take about 10 minutes.

The game is more designed for younger students, but could be modified for older ages. Educators can also add more discussion based on their class' level, and dive more in-depth into new solutions that could be made that may connect with the film, other lessons, other classes, and experience. The main draw for educators and students is the quick nature of the game, the ability to collaborate with other students, and the opportunity to connect cause, effect, and solution to real-world problems. The cards touch on many different subjects, and further discussion during and after the game meet many of the Next Generation Science Standards and the Vision and Change Standards for higher education. This activity uses collaborative pedagogy, such as Open-Ended Instruction, Active Learning, and Co-operative Learning to explain real-world ecological problems, such as native and invasive species, habitat loss, energy consumption, and living more sustainably in our day-to-day life.

Abstract

In the film Tree Tender, Gaia, our main Tree Tender, realizes that we can make a difference in slowing the loss of biodiversity together. There are many ways we can help, from decreasing our energy use, choosing environmentally friendly products, and contacting local governments. In better understanding our effect on the planet, we can better create solutions to help slow extinction rates. Your students will play a traditional matching card game, matching the problem we've created on this planet to a potential solution. After the game has been played at least once, the class will come together and discuss the assessment questions.

Learning

At the end of this activity, students will be able to:

- Understand some ways we affect the planet
- Connect a problem to a solution through context clues
- Use real world solutions to problems we've created
- Critically think of other ways we can help the planet

Timeframe and Materials

Instructor preparation takes about 30 minutes. Watching Tree Tender takes about 15 minutes. Playing the Tree Tender Matching Game should take no more than fifteen minutes per round.

You will need:

- Supplemental Tree Tender Matching Card Games
- Scissors

Procedures

1. After watching the film Tree Tender, have your students break groups of 2-3.
2. Print out the appropriate number of Tree Tender Matching Cards sets needed for the number of groups. Have students cut cards out carefully. Place cards print side-down.
3. Just as with a traditional memory game, students will flip two cards over during their turn.
 - The cards are not identical, but you will instead match the problem we've created on the planet with the corresponding solution.
 - If there is some confusion, key words are bolded and do match each other in both the problem and the solution cards.
 - When a student finds a match, they keep the cards and earn a point. The winning student does not draw again.
4. The game is over when all cards have been paired up. The student with the most pairs is the Ultimate Tree Tender!
5. After cleaning up, come back together as a class and discuss the assessment questions.
6. For more ideas on how to become a Tree Tender at home, visit our website (<https://www.treetender.org/about>)
7. **Modification for younger ages:** grades K-4 may have some difficulty with the language used on the cards. Before beginning the game, go over the following key words with your students, leaving their definitions on the board. See if your students can come up with the definition together:
 - Monoculture – growing a single plant or animal on a plot of land
 - Microorganism – living things that are too small to be seen with the naked eye, like bacteria, viruses, and mold
 - Unclaimed – land that is not owned by any one person or group
 - Biodiversity – variety of animal and plant life in an ecosystem or environment
 - Sustainable – using a resource in a responsible way so that the resource does not get used up or permanently damaged
 - Local – from nearby areas; in our case, it's food from nearby farms
 - Organic – food that is grown carefully with no harmful pesticide or herbicide use
 - Efficient – working without using a lot of resources or energy
8. **Modification for older ages:** when students make a match, have them come up with a second solution, to our environmental problem. Have the partners keep each other in check in making sure their solution is reasonable and uses knowledge from other lessons.

Assessment

- What were some of the environmental problems we have created on the planet?
- Are any of these problems new to you? Which ones?
- What are some simple ways you can help the planet and other organisms?
- Did any of these solutions seem hard? Which ones? How might we be able to come together and implement these solutions?
- Do you try and help the planet at home? How?
- How could you reduce the amount of energy you use at home?
- What other solutions can you think of to help the planet?

Next Generation and Vision and Change Standards Met

Next Generation Science Standards (K-12):	Vision and Change (for higher education):
<ul style="list-style-type: none">- Natural Resources-Human Impacts on Earth Systems-Ecosystem Dynamics, Functioning, and Resilience-Biodiversity and Humans-Science is a Human Endeavor	<ul style="list-style-type: none">-Tap Into the Interdisciplinary Nature of Science-Communicate and Collaborate with Other Disciplines-Understand the Relationship Between Science and Society

What was once beautiful **native plants** in your neighborhood is now only St. Augustine Grass.

This monoculture means you lost the native plants, animals, and microorganisms that live there.

When we sit in traffic on the way to school, we contribute to high **energy consumption**!

Transportation (especially cars) are one of the biggest contributor to Greenhouse Gasses in our atmosphere!

You heard a big company wants to build another store on a large plot of unclaimed land. This is land that we should **protect and restore** for plants and animals to live.

You convince your neighbors you can have an even more beautiful yard by planting **native plants**. You bring back many native insects and birds and improve soil health and water use!

You decide it isn't worth it to wait in traffic and you want to lower your **energy consumption**. You decide to take the bus, walk, or ride your bike!

You have a bake sale to raise money for a local organization that **protects and restores** habitat for other species to survive! Your sale make enough to buy a plot of land, and you help those species live!

Your pet cat, Scout, wanders around outdoors during the day. She keeps bringing you dead birds. You have no idea how Scout may be affecting the **local biodiversity**, but you have noticed fewer birds living in the neighborhood.

You found a cool plant you've never seen, and you have been trying to **learn more about nature around you**!

You really enjoy learning about biodiversity in your science class, but you've learned about the loss of biodiversity due to human action! You want to **support and advocate for biodiversity** even more!

You decide to keep Scout indoors to make sure she doesn't harm the **local biodiversity** of your neighborhood! An endangered species of bird moves back and begins nesting!

You found a Kid's Nature Club with great books and apps to help you **learn more about nature**! Not only are you learning, but you start sharing your knowledge with your best friend, too!

You start a Citizen Scientist group to **support and advocate for biodiversity**! You encourage and inspire classmates, their families, and the community to learn more and be a part of scientific research!

You found out your favorite candy uses palm oil and other ingredients that are not **sustainable, local, and organic**! You want to make sure the food you eat doesn't harm the environment.

You want to keep the mosquitos away this summer, but sometimes products that are not **environmentally friendly** can be hard on an ecosystem, harming other organisms!

Your parents are needing to upgrade some appliances, but they don't quite know what is the most **efficient**.

You find an alternative to your candy that uses **sustainable, local, organic** ingredients, and is the same price! Now, you can treat yourself without contributing to biodiversity loss!

You find a pest control with an **environmentally friendly**, plant-based mosquito spray! Now, you can have tons of summer fun without bug bites and without hurting the planet!

You help your parents do some research and find the most energy and water **efficient** appliances! They'll help you use less energy, water, and money in the long run!

Go Extinct! Educator Materials

This activity enforces learning through active movement and focuses on two major themes of the film: The Tree of Life and the Anthropocene Extinction event we are currently causing. There are three major parts of this activity and depth of content can be altered for both younger and older audiences.

The first activity has students separating themselves by their organisms' characteristics. This part is modified to your students' level, and example scenarios are listed in the procedures. The second activity has students ordering themselves in a linear representation of the Tree of Life. It is very important to note that this isn't a line representing how much more complex some organisms are over others. It is meant to be a characteristic matrix showing connectedness of organisms. The final activity is an anthropocentric extinction simulation that ties in real-world situations, and the option of having a Tree Tender save species during the game helps students use their experience and imagination to come up with possible, real solutions to help our planet.

The benefit of this activity is that students can participate in active learning, discussion, and connection of real-world events, the film, and the issues brought up in the game as well as core concepts in biology and ecology. Depending on grade level and depth of discussion, it can cover many different NGSS and Vision and Change Standards. The main pedagogy used here is Differentiated Instruction through active learning and Co-operative Learning. By looking at real-world issues, students will also experience Experiential Learning, Inquiry Learning, and Open-Ended Instruction, allowing them to explore real ways they can help our planet with their peers.

Abstract

Scientists use the Phylogenetic Tree to look at relationships between organisms, and have designed the Phylogenetic Tree by looking at different characteristics of organisms throughout time. As discussed in the film *Tree Tender*, all organisms are connected through this tree, though very distant at times. In ecosystems, such as the coral reefs, many of these organisms rely on each other for survival. When a species becomes extinct, we not only lose that organism, but many others that may depend on them. We are contributing to a mass extinction event, the Anthropocene Extinction. Your class will participate in a three-part activity exploring both the tree of life and the mass extinction events. The first activity explores ecological concepts, such as different traits of organisms and levels of classification. The second activity explores grouping these traits on a linear line to show how scientists once ordered organisms by morphological traits, and discussing links between species and the knowledge of a common ancestor. The third activity looks at our negative contribution to the current mass extinction event, allowing students to collaborate on changes they can make to save an ecosystem.

Learning

- Understand how scientists once arranged organisms in the Tree of Life by morphology
- Make connections between different organisms through active learning
- Understand similarities and differences between organisms
- Discover how human impact can affect different ecosystems
- Collaborate with classmates on solving real-world problems
- Understand the balance within food webs between plants, animals, and abiotic factors

Timeframe and Materials

Watching Tree Tender takes about 15 minutes. Each of the three activities should take about 10 minutes. Instructor preparation takes about 45 minutes to come up with what categories and scenarios will fit your students' level in Activities 1 and 2. If you are printing out pictures of organisms for your students, you will need about an hour.

You will need:

- Paper and Colored Pencils (If drawing organisms)
- Print-out Pictures of Organisms (If Skipping Optional Step)
- Large Space (Preferably outside)

Procedures

1. After watching the film, randomly assign organisms to students from the list provided
 - (OPTIONAL) Give the students a few minutes to draw their organism with its name.
 - If preferred, print out a picture of the organism for your students instead of drawing.
2. **Activity 1:** Begin by having the students stand in the center of the room or outdoor area. Students will now order themselves on opposite sides based on traits. Traits listed below start broad, and then become more specific. Some ways students can organize themselves is by:
 - Kingdom: Fungi, Plants, or Animals
 - Vertebrates vs. Invertebrates
 - Flowers vs. No Flowers
 - Asexual Reproduction vs. Sexual Reproduction
 - Warm-blooded vs. Cold-blooded
 - Fur vs. Feathers vs. Scales
 - Anapsid vs. Diapsid
 - Plant Defenses Present vs. Plant Defenses Absent
 - **Modification for older or younger** students: add or remove categories, as you see fits your students' grade level and previous lessons.
 - Remind your students that this is one way scientists have classified organisms.
3. **Activity 2:** Give your students a few minutes to form a single line based on how similar their organisms' morphological traits are to one another. To help, start with the slime mold on one end and the bison on the other. Have students compare different traits to each other to find the approximate order.

- Remind your students that the characteristics they practiced with in the first activity can be used to find out how closely related different organisms are (such as the same Kingdoms, Class, or Order being grouped together).
- Change from organism-to-organism should move gradually across the line, though you may see a jump between Kingdoms, from plants to invertebrates, and within mammals.
- It is most important that your students are collaborating and working together, even if the students don't come to the right conclusion. A list of the approximate order is provided. Make sure all students are participating and not just a few students leading.
- Once in line, ask your students how many steps it takes to get from two more closely related organisms (such as the dolphin and the wolf) and two distantly related organisms (such as the wolf and the sagebrush). Remind students that while they may be more distant from each other, they're still related and share a **Common Ancestor**.
 - Also stress that this line doesn't represent how complex or improved organisms are. It is meant to show interconnectedness through a characteristic matrix.
- Remind your students that when scientists originally began making the Tree of Life, they used morphological traits (just as your students have done), but can now get a better idea of evolutionary history through studying DNA called Phylogenetics.
 - Using DNA can give us a better idea of the relationships between organism. This concept is especially helpful for older students who many have talked about genetics, inheritance, and speciation already.

4. **Activity 3:** The ecosystems are now collapsing due to human impact.

- Divide students up based on the biome in which their organism occurs in (List provided).
- Have students discuss together how their organisms in their biome may interact.
- Have one student volunteer to be the Tree Tender along with representing their organism. The Tree Tender will save a species when the whole class votes to protect it.
- Instructor will shuffle the cards provided, drawing a card, one at a time. Cards will have a human action and how it affects one or two species in any given biome.
- When an organism in the exercise goes extinct, that student representing it must sit.
 - Before the student sits, the classroom has an opportunity to vote on saving the species. This may be done THREE TIMES during the entire game.
 - If there is more than one organism affected on the card, a majority of the class must vote to save the first species before the second is read.
 - The Tree Tender must come up with a solution on how they will save the species based on how the species is being harmed in the narrative.
 - All students can assist the Tree Tender in finding this solution, as it is up to everyone on the planet to come together and find a solution to the problems we've caused.
- The game ends when you either run out of cards (in which the whole class wins) or you run out of species (in which the whole class loses).
- The game should move quickly, so the class can try multiple rounds to see what outcomes they reach. Have other students volunteer as the Tree Tender as well.
- For an added activity, you can calculate the percentage of species remaining in each round by using the following equation:

$$\frac{\text{Species Remaining at the End}}{\text{Total Number of Species}} \times 100$$

Organism and Biome List

In the table below, you'll find each of the four biomes represented in this activity with the organisms living in each one. Each student will represent one organism.

Deserts	Marine	Prairie	Woods
Sagebrush	Kelp	Prairie Grass	Pine Tree
Cactus	Coral	Wildflower	Fern
Fungi	Crab	Slime Mold	Pitcher Plant
Bee	Fish	Grasshopper	Earthworm
Tortoise	Shark	Flycatcher	Bird
Kangaroo Rat	Dolphin	Wolf	Snake
Bat		Bison	

Approximate Order (Activity 2)

The list below shows the approximate order for students to order themselves. If confusion occurs the basic order is plants (with the angiosperms, or flowering plants, occurring last), invertebrates, fish, reptiles, birds, and mammals.

- Slime Mold
- Fungi
- Fern
- Pine Tree
- Kelp
- Prairie Grasses
- Sagebrush
- Wildflower
- Cactus
- Pitcher Plant
- Coral
- Earthworm
- Bee
- Grasshopper
- Crab
- Fish
- Shark
- Snake
- Desert Tortoise
- Flycatcher
- Bird
- Kangaroo Rat
- Bat
- Dolphin
- Wolf
- Bison

Next Generation and Vision and Change Standards Met

Next Generation Science Standards (K-12):	Vision and Change (for higher education):
<ul style="list-style-type: none"> - Natural Resources -Human Impacts on Earth Systems -Ecosystem Dynamics, Functioning, and Resilience -Biodiversity and Humans -Developing Possible Solutions -Interdependent Relationships in Ecosystems -Variation of Traits -Inheritance of Traits -Evidence of Common Ancestry and Diversity -Stability and Change -Weather and Climate -Global Climate Change 	<ul style="list-style-type: none"> -Tap Into the Interdisciplinary Nature of Science -Communicate and Collaborate with Other Disciplines -Understand the Relationship Between Science and Society

An enthusiast of ornamental plants takes home a few cactus, but was unaware it was an endangered lacy cactus! The cactus is now extinct in the wild.

(Cactus Player sits)

Because the cactus is gone, it takes more energy for the bee to go plant to plant, causing many to die out.

(Bee Player sits)

Climate change can affect the amount of rainfall that occurs in the desert.

Excessive drought has made it difficult for the sagebrush to survive!

(Sagebrush Player sits)

The Kangaroo Rat once lived among the roots of the Sagebrush, but has lost a habitat and food source.

(Kangaroo Rat Player Sits)

A new landfill is constructed near the desert, forcing many desert tortoises out of their homes and making it difficult for the tortoises to find resources. These animals have been seen walking great distances, only to be struck by cars. The tortoise is driven to extinction.

(Tortoise Player Sits)

Climate Change has made it unbearably hot in the desert, causing the hedgehog mushroom to die off.

(Fungi Player Sits)

Without decomposers, like fungi, nutrients aren't replenished into the soil, making it hard for plants to live!

(Sagebrush Player Sits)

Cats from local residents in the desert have been left outdoors to roam free.

This means that many species, like the Kangaroo Rat, are hunted for the cats' entertainment.

(Kangaroo Rat Player Sits)

When decomposers aren't around to clean up deceased animals and plant material, disease can quickly spread.

A desert bat picks up a disease and takes it back to the rest of its colony, causing problems for hundreds of individuals!

(Bat Player Sits)

As we use energy and burn more fossil fuels, we cause an increase in global temperatures, making it hard for zooxanthellae to survive. Coral bleaching has increased, and all the coral on the reef is gone.

(Coral Player Sits)

Much of the plastic we use has found its way to the ocean. Animals, such as the dolphin, mistake the plastic for food. This pollution made the dolphin sick and drove them to extinction.

(Dolphin Player Sits)

Irresponsible pet owners dump lion fish from their aquariums into the ocean. The lion fish become very invasive, outcompeting many of the local fish species for resources.

(Fish Player Sits)

Trawling (pulling a net behind a boat) for shrimp has pulled up much of the kelp. With so little kelp left, there is no way it can come back.

(Kelp Player Sits)

The loss of the kelp means a loss of oxygen and food for the fish and the shark.

(Fish and Shark Players Sit)

Loss of habitat, like coral reefs, kelp forests, and mangroves, has contributed to the loss of many species. Without a place to live, the crab has a harder time finding food and shelter!

(Crab Player Sits)

When we burn coal, we contribute to mercury pollution in the ocean. Animals at the top of the food chain, like the shark, have higher, sometimes toxic, levels of mercury due to biomagnification.

(Shark Players Sits)

The buffalo were over-hunted and are no longer living on the prairie.

(Bison Player Sits)

The Buffalo was crucial to maintaining the prairie grasses. Without the buffalo, other plants take over and the native Switchgrass disappear.

(Prairie Grass Player Sits)

A city develops homes and shopping centers on a once beautiful prairie, fragmenting and destroying many of the wildflowers!

(Wildflower Player Sits)

With the loss of wildflowers, fewer insects buzz in the prairie, leaving the Flycatcher with little to eat!

(Flycatcher Player Sits)

The wolf is seen as dangerous to many local farmers. People hunt the wolf to extinction.

(Wolf Player Sits)

When the apex predator is gone, many of the common deer in the area become overpopulated and overgraze the healthy grasses.

(Prairie Grass Player Sits)

Nearby corporate farms use pesticides on their plants, but that doesn't stop these toxins from getting into the prairie. The grasshoppers on the prairie are unable to survive.

(Grasshopper Player Sits)

A bird watching group opens up a stretch of prairie for ecotourism in the area. This helps some flycatcher populations return to their original nesting site.

(Flycatcher Player Stands)

Fire used to be very important to the ecology of the prairie. In performing prescribed burns, many native grass and wildflower species return!

(Wildflower and Prairie Grass Players Stands)

The *Fuligo* slime mold returns to decompose and recycle nutrients to the earth!

(Slime Mold Player Stands)

Loggers come to find the pine trees in a nearby wooded area to be an excellent resource. They cut all trees in the area down.

(Pine Tree Player Sits)

The Bluebird loses many of the wonderful nesting sites and has to leave the area.

(Bird Player Sits)

Nearby oil and gas extraction has created quite the noise disturbance, making it difficult for local birds to raise their offspring. The birds decide to move away.

(Bird Player Sits)

Pollution from a nearby manufacturing plant seeps into the soil, harming the earthworm.

(Earthworm Player Sits)

The earthworm is important in recycling nutrients into soil. Without that healthy soil, the Fern does not have enough resources to survive.

(Fern Player Sits)

Feral Hogs rip up much of the vegetation in the woods, including the Pitcher Plant. The hogs rip up the last remaining patch of these amazing, beautiful plants!

(Pitcher Plant Player Sits)

Introducing non-native species to an ecosystem, like the Burmese python, can have catastrophic effects on local populations. A local King Snake species has a hard time finding food with its new neighbor around.

(Snake Player Sits)

Climate change and deforestation have caused an increase in soil erosion in the area, leaving less land area for the fern to grow.

(Fern Player Sits)