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Wildfire Awareness Curriculum Grades 6- 12

Palau

Edited by Koh Ming Wei

**Authored by Ashley Acuña, Moñeka De Oro, Mary
Garvilles, Kyle Quinata and Ann K. Singeo**

**Contributors- Amanda Uowolo,
Christine Camacho Fejeran, and
Clay Trauernicht**

**WILDFIRE AWARENESS
CURRICULUM
GRADES 6 – 12
PALAU VERSION
JULY 2020**

AUTHORS

MOÑEKA DEORO, JUST
TRANSITION POLICY AND
CURRICULUM FELLOW WITH
MICRONESIA CLIMATE CHANGE
ALLIANCE.

MARY GARVILLES, HIGH SCHOOL
SCIENCE TEACHER, GUAM
DEPARTMENT OF EDUCATION

KYLE QUINATA, MIDDLE SCHOOL
SCIENCE TEACHER, GUAM
DEPARTMENT OF EDUCATION

ASHLEY ACUÑA, HIGH SCHOOL
SCIENCE TEACHER, GUAM
DEPARTMENT OF EDUCATION

ANN K. SINGEO, EXECUTIVE DIRECTOR, EBIL SOCIETY, REPUBLIC OF PALAU.

CONTRIBUTORS

AMANDA UOWOLO, PROJECT PRINCIPAL INVESTIGATOR, ECOLOGIST, USDA FOREST SERVICE,
PACIFIC SOUTHWEST RESEARCH STATION, HILO, HAWAII

CHRISTINE CAMACHO FEJERAN, COOPERATIVE FIRE PROGRAM MANAGER, FORESTRY & SOIL
RESOURCES DIVISION, GUAM DEPARTMENT OF AGRICULTURE

CLAY TRAUERNICHT, PHD, ASSISTANT SPECIALIST, DEPARTMENT OF NATURAL RESOURCES AND
ENVIRONMENTAL MANAGEMENT, COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES,
UNIVERSITY OF HAWAII AT MANOA

EDITOR

KOH MING WEI, PHD, LEAD EDITOR, PROJECT COORDINATOR, AND CURRICULUM FACILITATOR,
CENTER FOR GETTING THINGS STARTED



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INQUIRIES CAN BE DIRECTED TO:

AMANDA UOWOLO
USDA FOREST SERVICE
INSTITUTE OF PACIFIC ISLANDS FORESTRY
60 NOWELO STREET
HILO, HI 96720
WWW.FS.FED.US
AMANDA.L.UOWOLO@USDA.GOV
808-854-2663



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Fire is a human phenomenon on islands

- Clay Trauernicht.

Fire is neither good nor bad. How fire is used however, can have positive or negative outcomes. **All wildfires on the Pacific Islands are human caused.** Therefore it is up to us to manage fire well and to prevent its unchecked spread. Through this place-based curriculum, our goal is to educate local students on the cultural significance and important practical uses of fire, the occurrence of wildfires in our communities, the value of our different ecosystems in our islands and the resources these ecosystems provide that wildfires threaten, the diverse impacts wildfires have from the tops of our ridges to the reefs that feed our communities, how wildfires occur, how they are controlled, and how they can be prevented. After a decade of diverse program efforts to reduce wildfire in Guam and the U.S.- affiliated Pacific Islands (USAPI), a multidisciplinary team that included staff from Ebiil Society, Guam Forestry, the USDA Forest Service, the University of Hawaii at Manoa, Center for Getting Things Started, region-based educators, and cultural experts came together to develop this place-based grade 6-12 wildfire awareness curriculum.

In this curriculum, we explore 4 themes or Big Ideas:

- **Sense of Place, Sense of the Issue** - place shapes how we view and use fire;
- **The Science of Fire** - the fire triangle;
- **Ridge to Reef** - how fire on the hills directly impacts the ocean; and
- **Fire Prevention** - why prevention is less costly than fire suppression.

Our intention is that these units and lessons can be used by educators in the Pacific Islands to deepen students' relationship with place, to engage with complex science concepts, and to co-create a resilient future.

Sulang,
The Wildfire Awareness Curriculum Team



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Overview & Objectives

UNIT	OVERVIEW	OBJECTIVES	NGSS & GDOE STANDARDS
01: SENSE OF PLACE	To understand cultural values and connect students to natural resources of the Mariana Islands, thus establishing a strong sense of place. To create awareness about wildfires and their causes, impacts and prevention. To foster stewardship and create a generation of Future- Makers.	Student will: <ul style="list-style-type: none"> • Develop a strong sense of place for Palau and the Oceania Region • Understand interconnectedness of life and evaluate their own behaviors and values and its impacts on the environment • Locate islands of Micronesia and Oceania on a map • Name and identify the different habitats of Palau • Understand/ explain the different threats to the health of the Islands' environment • Compare and contrast endemic, invasive and native species of the islands • Identify habitats and areas most vulnerable to wildfires on the islands 	NGSS: <u>Earth and Human Activity</u> <ul style="list-style-type: none"> • <u>ES3-3:</u> Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. <u>Ecosystem</u> <ul style="list-style-type: none"> • <u>LS2-1:</u> Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. • <u>LS2-5:</u> Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
02: SCIENCE OF FIRE	Students will understand that fire is a natural part of our environment and be able to tell the difference between useful and harmful types. They will learn about the causes of wildfire and the three elements fire needs to exist. The main goal of these lessons is to teach students to reduce the number of human-caused wildfires by promoting safe behavior when using fire.	Student will: <ul style="list-style-type: none"> • Understand how easily a wildfire can start and get out of control. • Know safe fire practices when camping. • Know the consequences of uncontrolled fires. • Be able to discuss the risks of playing with fire. • Know to call for help immediately/ report to the authorities if a fire is getting out of control. • Know to call for help immediately/ report to the authorities if they see any signs of wildfire. • Report any suspicious fire play activity to the authorities immediately. 	NGSS: <u>Earth and human activity</u> <ul style="list-style-type: none"> • <u>ES3-2:</u> Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development. • <u>ES3-3:</u> Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. <u>Ecosystem</u> <ul style="list-style-type: none"> • <u>LS2-1:</u> Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. <u>Engineering Design</u> <ul style="list-style-type: none"> • <u>ETS1-1:</u> Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. • <u>ETS1-2:</u> Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Overview & Objectives Continued

UNIT	OVERVIEW	OBJECTIVES	NGSS & GDOE STANDARDS
03: RIDGE TO REEF	Students will create solutions to prevent wildfires which will help protect our natural resources from the ridge to the reef. They will also learn the different roles government and nongovernmental organizations play in managing our natural resources.	Student will: <ul style="list-style-type: none"> List the natural resources on Palau Explain the importance of different natural resources List the different agencies that help manage Palau's natural resources Create solutions to help prevent wildfires Differentiate between managed and unmanaged fires Identify native plants that will be used in the reforestation project 	NGSS- Middle School: <u>Earth and human activity</u> <ul style="list-style-type: none"> MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services
04: FIRE PREVENTION	Students will understand why we should focus on prevention (vs suppression) of wildfires. Students will create posters that explain the major heat sources for Palau's wildfires and propose solutions to eliminate those sources.	Student will: <ul style="list-style-type: none"> Understand the difference between suppression and prevention Identify ignition sources Explain how those ignition sources can create large scale wildfires Propose solutions to prevent wildfires 	NGSS: <u>Engineering Design</u> <ul style="list-style-type: none"> <u>ETS1-1</u>: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. <u>ETS1-2</u>: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. <u>ES3-3</u>: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment <u>HS-ETS1-3</u>: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Unit 1- Sense of Place

The goals of Unit 1 are to understand cultural values and connect students to the natural resources of Palau islands, thus establishing a strong sense of place; to create awareness on wildfires and their causes, impacts and prevention; and to foster stewardship and create a generation of FUTURE- MAKERS.

	LESSON	OBJECTIVES	STANDARDS
Lesson 01	Sense of Place	Student will: <ul style="list-style-type: none">• Develop a strong sense of place for Palau, the Marianas, Micronesia and the Oceania Region• Understand the interconnectedness of life and evaluate their own behaviors, values and impacts on the environment• Locate islands of Micronesia and Oceania on a map• Name and identify the different habitats of Palau• Understand the different threats to the health of the islands' environment• Compare and contrast endemic, invasive and native species of the islands• Identify habitats and areas most vulnerable to wildfires on the islands	NGSS: <ul style="list-style-type: none">• <u>ES3-3</u>: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.• <u>LS2-1</u>: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.• <u>LS2-5</u>: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
Lesson 02	Sense of the Issue		

Introduction

Palau's forest has provided for the Palauan people for thousands of years. According to archaeological studies using residue of plants and seeds in the soil, Palau is considered the stepping stone of the Pacific, with human settlements dating back to some 3000 years ago (Liston 2005, Fitzpatrick 2002). Palau islands were created over 40 million years ago by the subduction of the Pacific plates (Kayanne 2207). Palau legends retell stories of ancient Palau where a giant clam would emerge an island from the bottom of the sea and would bare a male child who would govern the heavens and female child to govern the land and create what becomes the culture of Palau, and a third child who would become the female giant god, Chuab, who would be burnt by the seven gods-Tekiimelab, to create the Palau islands. Palau oral history consists of many stories of human like beings who would later on be transformed into creatures of the forest and the ocean baring the same characteristics of the human like being. A similar story is that of Kisaks and Ngirarirs bearing two children named Dort and Blacheos which at current are native tree species of Palau. *Use Kisaks story book for reference and activities.*



LESSON 1: GROUNDING- OUR SENSE OF PLACE- OUR SENSE OF THE ISSUE

Remembering Our Ancestors, Acting For Our Descendants

Before we begin to learn of fire as a destruction to a healthy forest, we must develop understanding of our relationship to the forest for better understanding of fire impact on our lives. The Palauan language referring to fire changes with the use. When referring to fire used for cooking, crafting, boiling, for warmth, and when the use refers to a positive action it is called 'ngau.' When fire is destructive in situations such as forest fires, fire on properties such as houses or farmland, or life, it is called, 'seseb.' However we have to keep in mind situations where 'seseb' is used to create positive changes, such as clearing fields for farming, or the legend of 'Chuab' where the giant female god is burnt by the seven gods- 'Tekiimelab,' thus creating the Palau Islands.

Palauan Values

Values are cultivated as part of a person's upbringing, culture, and education, all of which are founded upon the environment in which we live. Learning of indigenous knowledge and scientific information provides for a richer understanding of one's environment. The science provides general information of the topic while indigenous knowledge provides intricate details of information specific to the environment based on the relationship of the people and their use of the natural resource. For instance, the indigenous Palauan approach towards the forests is that of a borrower in-debt to the giving of the forest, reminding humans to always ask for permission to enter, to use, and to take from the forest. We must always be conscious of the essence of the forest, 'chengal,' and always ask for permission when interacting with the forest and the land.

Science provides the knowledge of the biodiversity and processes to better understand the cause and effect in environmental changes. Together, they provide a deeper knowledge of our own environment and keener sense to protect and conserve for a harmonious relationship.

Class discussion- compare and contrast what makes one a Future Maker versus a Future Taker?

The difference between being a Future Maker and a Future Taker is your behavior. Respect or *Omengull* is a central Palauan value. You must have respect for yourself, for others, for our forest, our oceans, and our Mother Earth. The health of the environment equals the health of the people who reside on that land and depend on that ocean. These lessons will focus on the issue of wildfires on our islands. This is a science curriculum but it also is interdisciplinary with subjects such as social studies and the Palauan culture and language.

A major goal of this curriculum is to grow the next generation of environmental stewards. Lesson 1 sets the foundation for the value sets we hope to pass on to our students. Grounding youth in cultural knowledge and native songs and stories establishes a strong sense of place. Learning the geography of not just one specific island but our archipelago and our wider Micronesia and Oceania region is important. We exist in a sea of islands, learning more about our place in the vast Pacific Ocean will help us to become more self reliant and interdependent as islanders.

Palauan Culture

We will explore the relationship between humans and the forest to better understand the cultural value of the forest to the Palauans. Palauan teachings says, "that unto a keai (beattlenut frond) we are born, and into a chedecholl (pandanus mat) we are buried." Palauan teachings also say that for every stage of life and human development we depend on the forest for our life.



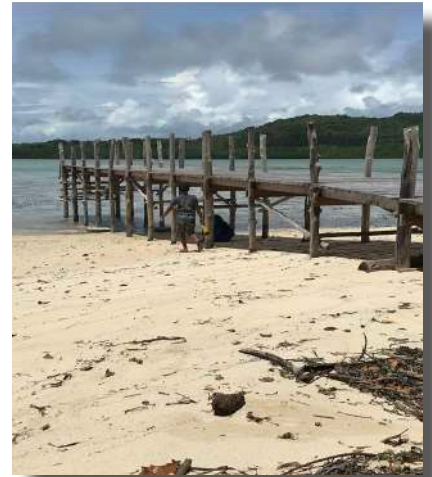
Ethnobotany is the study of people and their use of plants. Let's look at how we have used the forest.

Food- plants with edible products such as coconut or *lius*, lemon or *meradel*, banana or *tuu*, nuts or *miich*, breadfruit or *meduu*, food processing, etc.



Medicine- plants used for healing and treatment of illness, such as *ongael*, *kirrai*, *emudelach*, *kobesos*, *dudurs*, *elangel*, and *kesiil*, to name a few.

Architecture- plants used to build Bai, homes, canoes, and other types of structures such as *teuechel*, *ukall*, *bamboo*, *mekekad*, *dort*, *batches*, etc.



Fishery- Plants used for fishing activities, such as vines or *kemokem* for stringing fish and lines, *elangel* for hooks, *bisecherad* for lures, *raad* for fish traps, *demaier* for net fishing, etc.

Agriculture- plants used for fertilizer, mulch, fungus treatment, water dam building, tools for planting, such as *milleta* or *kisaks*, *Pterocarpus* or *las*, *Noni* or *ngel*, *churur*, *Banana* or *tuu*, *beattlenut* or *buuch*, *hibiscus* or *chermall*, etc.

Humans depend on the forest for everything mentioned above including the air we breathe, cooling of the Earth's temperature, aesthetic purposes, water conservation, healthy productive soils, healthy reef, and a healthy planet for us to live in.



The Island Environment

Palau is geologically divided into two domains: (1) Babeldaob volcanic areas including parts of Koror and nearby smaller islands; and (2) the limestones islands mostly referred to as Rock Islands. The differences in soil composition, topography, and drainage provides for a diverse habitat and biodiversity (Cole, et al. 1987). We will pay special attention to 6 of Palau's natural forests and what they look like.

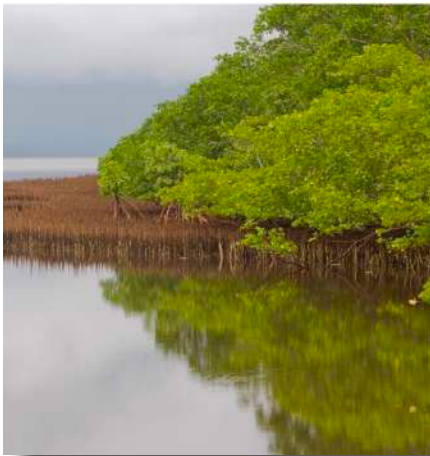
1. **Upland forests or *Choreomei***- are found on the high volcanic islands. The upland forests of Palau are the most species- diverse in Micronesia and contain several endemic species.



2. Swamp forests or *Dolomeklochel*, are found in low-lying areas, just inland of mangroves and above tidal influence. A large area of this forest has been altered and cultivated for thousands of years by Palauan women as *Mesei* or taro patch.



3. Mangrove forests or *Keburs*, Mangrove forests occur along the lower portions of rivers, on coastal mudflats, and on some offshore islets.



4. Coastal Forests or *Rriil* and *Kebokeb* forests are found toward the interior of the coastline and are generally located behind the strand zone, but may be mixed with strand vegetation.



5. **Limestone forest or *Elbacheb*** with a subtype in the Rock Islands; Limestone forest is found on the coral islands of Peleliu, Angaur, and the Rock Islands. The species composition varies from island to island, and various endemic species are present. The habitat of all limestone forests is similar; humus from decaying vegetation provides a sustained cycling of nutrients.



6. **The Rock Island or Elbacheb forest** is a subtype of limestone forest that is extremely diverse in species composition. (The Rock Islands are a cluster of extremely steep karst-weathered limestone islands that extend from Koror Island south toward the island of Peleliu.)

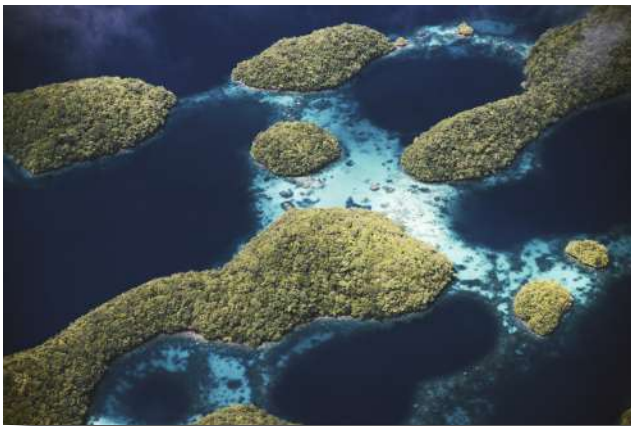


PHOTO CREDIT: © [MICHELE WESTMORLAND/
DANITA

FOREST HEALTH

What makes it healthy and bountiful as well as what threatens its health and productivity? Palau's forest is considered a World Biodiversity Hotspot requiring special attention on preventing loss of habitat and biodiversity (CEPF report 2017). There are a total of **36** World Biodiversity Hotspots on the planet.



Biodiversity means the variety of habitats and species, genetics, and ecological processes related to an area. A 'hotspot' is where the variety of these factors are extremely high (CEPF 2017). Palau's 84% forest cover plays a critical role as carbon sink of the planet by removing an estimated 98.57 Gg of CO₂ or 30% of Palau's total emissions (331.84 Gg) annually (OERC 2007). Numerous animals depend on the forest for their lives, such as birds, snails, reptiles, and bugs to name a few. Without the forest life would be difficult for humans and animals. Palau has a total of 802 native species of plants of which 150 (19.57%) are considered endemic (Kitalong 2008). The island has a total recorded resident and visitor birds of 169 with 16 of which are restricted range species. Follow the links below to see more on Palau bird reports.



Links to Palau bird report:

- https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwi_lpW4ltHpAhXFzls-BHa9OAAcQFjABegQIBRAB&url=http%3A%2F%2Fdatazone.birdlife.org%2Feba%2Ffactsheet%2F191&usg=AOv-Vaw3Zlhkdw9cBE5vYIIZcsoEVh
- <https://www.palauconservation.org/wp-content/uploads/2019/05/State-of-Palau-Birds-2017.pdf>



LESSON 2: SENSE OF THE ISSUE

When habitats are altered and processes are interrupted is when a forest becomes unhealthy, thus affecting those depending on the forest for survival. For instance, when a super typhoon eliminates a large area of forest, the land becomes extremely hot and birds and other animals face hunger. Forest resources depended on by humans will no longer be available as resource shortages are experienced. For the purpose of understanding the effects of forest fire on our natural resource we will focus on forest fires in Palau.



PHOTO CREDIT: FIRE IN MELEKEOK UPLAND FOREST. PHOTO BY BAKAS MIRA

Role of fire in our lives- Drawing activity. Have the students reflect and draw on what ways fire has been used and what fire means to them in their personal lives.

PALAUAN WORDS ASSOCIATED WITH FIRE

chab -gray/ash

chat- smoke

cheliliik-
dry (Air dry)

melau- to heat something for the purpose of molding as part of crafting or for using heat from fire wood or river pebbles for treating poisonous injuries

melengois- cooking or steaming protein in elais-coconut baskets or keai-beattlenut fronds

meleseb- burn

meliokl- cooking of starch like taro, tapioca, and keam chestnut with firewood

melul- barbecue

mengat- Palau new house blessing ritual using herb to smoke the house while reciting incantations and prayer or Palauan steam medicine using herbs in a spa-like setting or to smoke house or farm to chase away unwanted bugs

mengeald- to heat for warmth or hot food

ngau- fire

omkard- to make light

omtaut- to light fire



Fire as a Tool (help vs. harm) Lead a class discussion on ways that fire is helpful and compare and contrast it with how fire can be harmful in our islands.

Wildfire vs. Controlled Fire

- Causes
- Impacts/Consequences- Why we should we care?
- Human health- Environmental health
- What areas are vulnerable to wildfire and why?



Babeldaob forest is constantly under threat of fire. Since 2012, US Forest Service has continued to map forest fire incidents on Babeldaob. A total of .07% of Babeldaob's forest is burnt annually. All forest fire in Palau and similar to most of the Pacific Islands is caused by humans.

In this curriculum we will focus on '*seseb*,' or the destructive fire in relation to our natural resource of forests and our intricate relationship as borrowers of goods and services from the forest. Characteristics of Palau's fires include the following;

- The majority of the areas burnt are on savannah areas or grassland
- Causes of fire include escaped fire as a result of burning clearing of farmland, burning of natural debris while cleaning properties or on the road side, hunters clearing a path, and field workers burning to clear areas around power line poles, land markers, historical sites, etc.
- The biggest fire incident ever recorded took place on Ngatpang upland forest which burned for four days and engulfed a total of 180 acres of forest.
- The majority of Palau's fires take place during Easterly Tradewinds, '*Ongos*,' the dry season for Palau
- The same areas are consistently burnt every 2-3 years after the vegetation has recovered from the last fire



What can you do to reduce wildfire in Palau?

As individuals we have the power to decide the type of steward we want to be. More importantly having the knowledge and the tools you need to do good things is critical. Often times people say, “protect the forest!” ‘How’ is often not provided as part of the information. In this curriculum, part of what you will learn is the ‘how.’ Here are some solutions that you can participate in to be a better steward of you island home.

- **Report forest burning.** If you see suspicious activities of forest burning call the fire department at 911 and report what you see and where. Paying attention to detail is important.
- **Apply for a burn permit** so you can get the information you need to do it properly and minimize risks and hazards
- **Avoid burning during dry and windy seasons** when forest fire risks are high. Instead use the natural debris to mulch a garden or an area of trees for a good fertilizer.
- **DO NOT leave fire unattended** if you have started a fire. Leaving fire unattended increases the risks of uncontrolled fire that can destroy forests and personal property.
- **Join tree planting events or volunteer groups** so that you can be part of the solution to restore native forest and reduce degraded land areas as a result of fire.

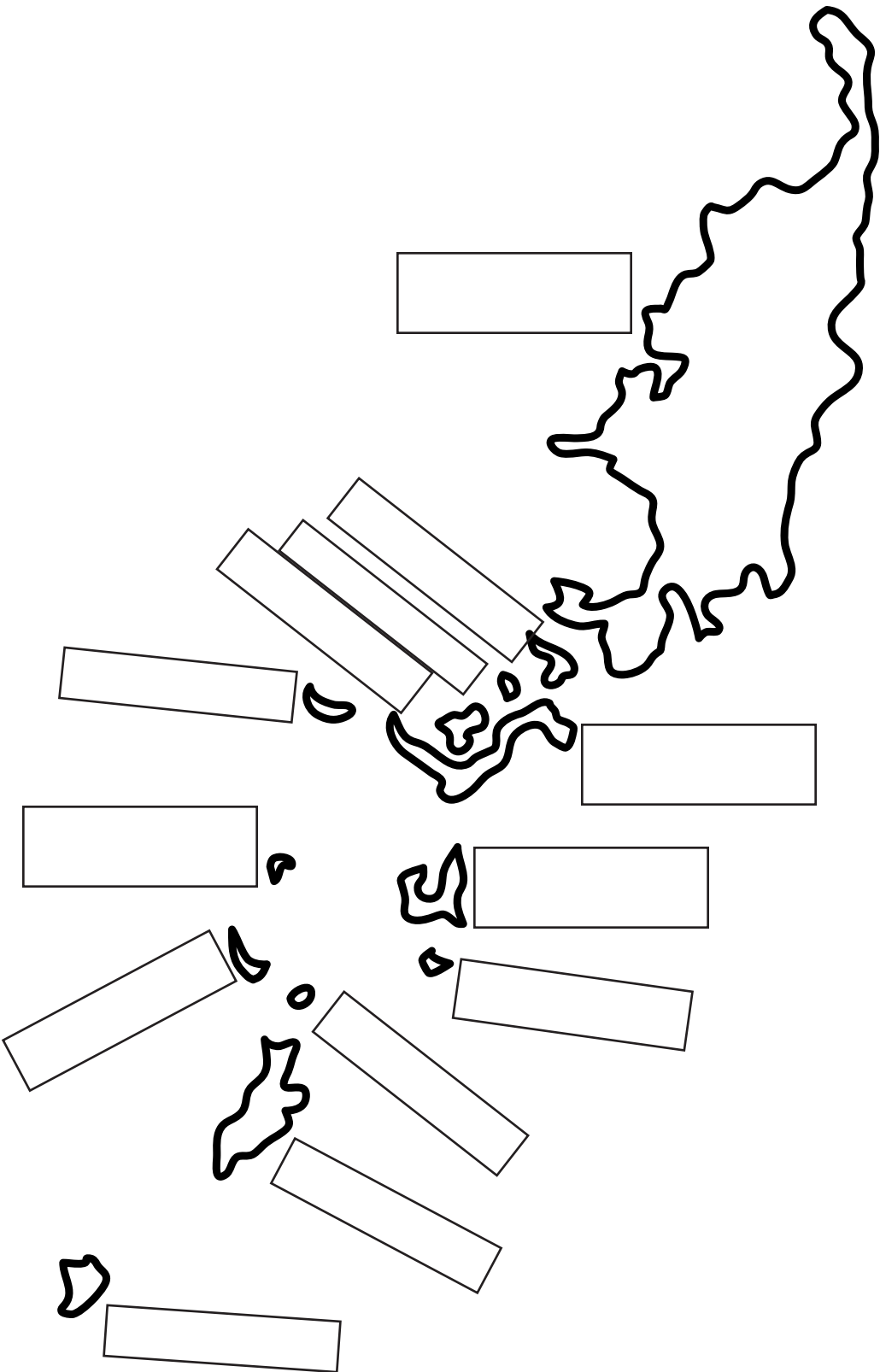


More videos on Palau for developing a greater sense of place and values:

<https://video.nationalgeographic.com/video/00000150-961d-d9fe-abf5-be3dfab80000>

<https://video.nationalgeographic.com/video/0000014d-e87f-d444-a35f-e97f4c020000>

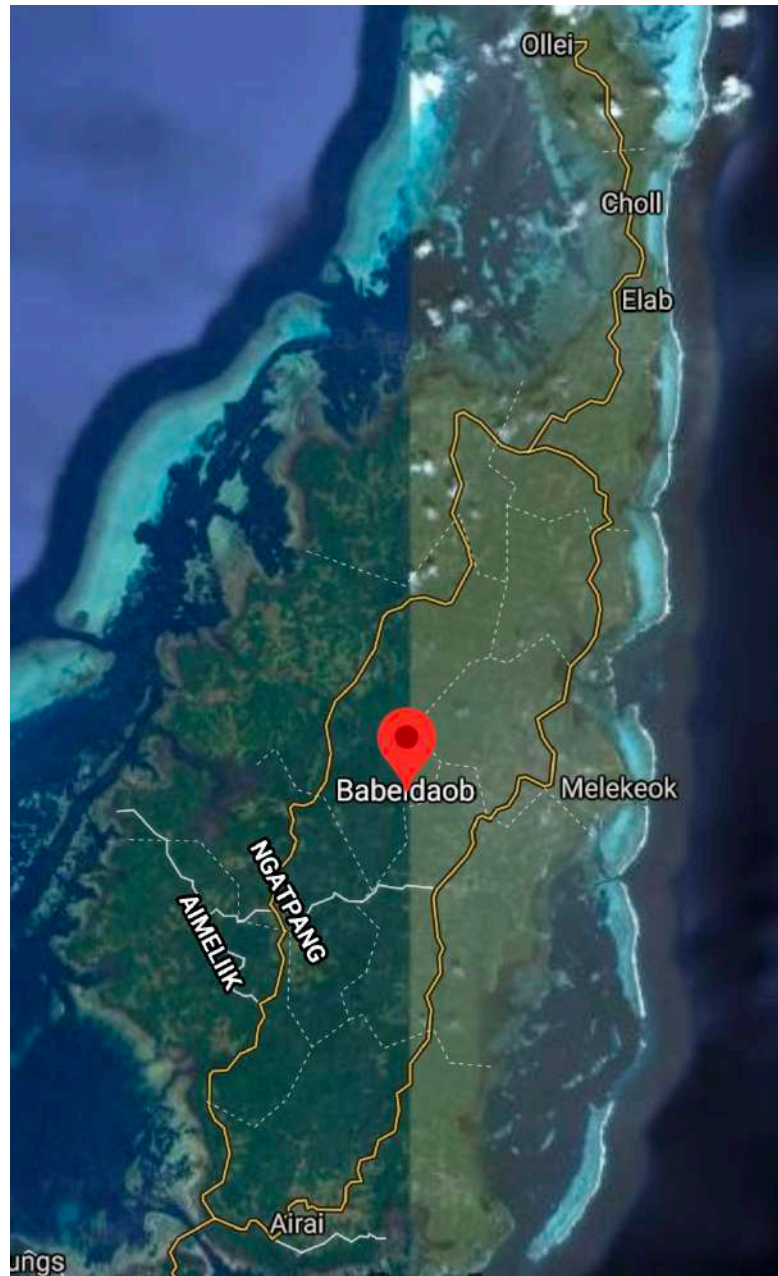
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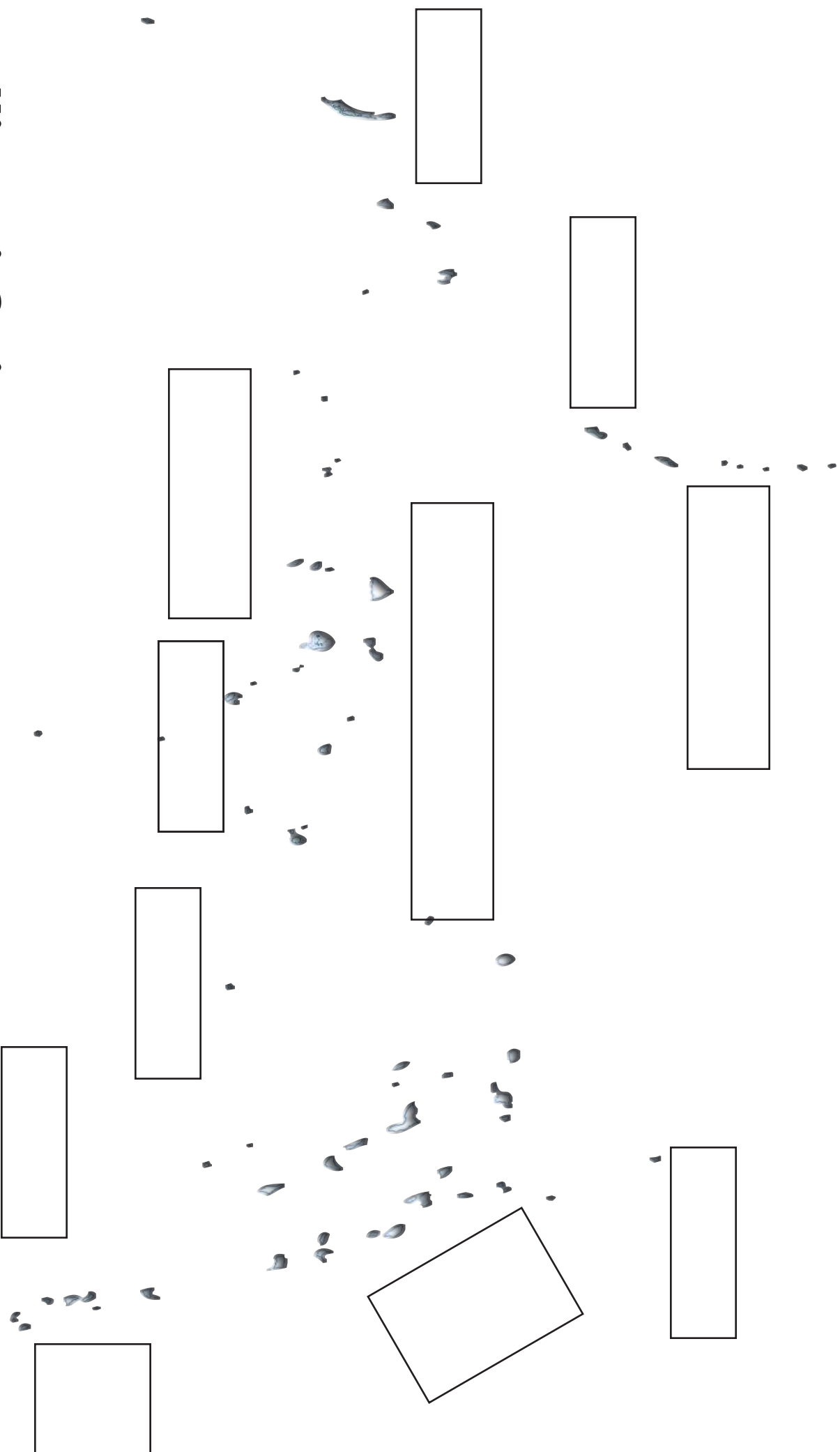
MAP SOURCE: ADOBE STOCK, 174571348



Babeldaob



Micronesia Region





Oceania

LABEL MICRONESIA,
MELANESIA,
POLYNESIA,
AUSTRALIA AND
NEW ZEALAND



Unit 2- Science of Fire

The goals of this unit include the following: Knowledge- Students will understand how easily a wildfire can start and get out of control. Students will know about safe fire practices and the consequences of uncontrolled fires. Behavior- Students will be able to discuss the risks of playing with fire, will know to call for help immediately/report to the authorities if a fire is getting out of control and is becoming a wildfire, and will know to call for help immediately/report to the authorities if they see any signs of wildfire. Students will report any suspicious fire play activity to the authorities immediately.

	LESSON	OBJECTIVES	STANDARDS
Lesson 01	The Fire Triangle and What Fire Needs to Burn	Student will: •Knowledge <ul style="list-style-type: none"> Understand how easily a wildfire can start and get out of control. Know about safe fire practices Know about the consequences of uncontrolled fires. •Behavior <ul style="list-style-type: none"> Be able to discuss the risks of playing with fire. Call for help immediately/report it to the authorities that a fire is getting out of control and is becoming a wildfire. Call for help immediately/report it to the authorities if a learner sees any signs of wildfire. Report any suspicious fire play activity to the authorities immediately. 	NGSS: <u>Earth and human activity</u> <ul style="list-style-type: none"> <u>ES3-2</u>: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development. <u>ES3-3</u>: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. <u>Ecosystem</u> <ul style="list-style-type: none"> <u>LS2-1</u>: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. <u>Engineering Design</u> <ul style="list-style-type: none"> <u>ETS1-1</u>: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. <u>ETS1-2</u>: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
Lesson 02	The Fire Behavior Triangle		
Lesson 03	The Fire Regime		

Introduction

BACKGROUND INFORMATION

Wildfire Definition: *An unplanned and uncontrolled fire spreading through vegetation, at times involving buildings.*

More people are building their homes in what is called the **wildland-urban interface**. This is where development meets the natural environment. The danger of wildfire is very real in these areas, especially when surrounded by natural savanna areas that are prone to wildfires.

- **Every** wildfire requires some spark or fire to start it.
- **100%** of wildfires in Palau are started by people.



These are the main causes of wildfires across the islands. Human ignitions are the cause of ALL OF PALAU'S wildfires.

- **Intentional:** Fires are sometimes set illegally in natural areas on purpose. This is known as **arson**.
- **Land clearing for agriculture:** Fire is often used to clear forested areas to make gardens and farms. These types of fires, if not well managed, can escape beyond their intended areas into adjacent lands and spread.
- **Burning of debris:** Permitted and unpermitted burning of debris if poorly managed, or if weather conditions change suddenly, can escape beyond their intended area and cause wildfire in adjacent areas and spread.
- **Land clearing for hunting:** Fires are sometimes set illegally in natural areas to clear the area of vegetation for access to areas used by bird hunters.
- There are other ignition sources that could also cause wildfires like: improperly discarded cigarette butts, sparks from machinery, and blown embers from outdoor cooking fires

Data was collected by Palau Forestry and the USDA Forest Service on the reasons for all wildfire ignitions in Babeldaob in 2012 and 2013:

REASON FOR WILDFIRE IGNITION	PERCENTAGE OF TOTAL FIRES
ARSON	36%
LAND CLEARING FOR FARMING	26%
BRUSH PILES	19%
LAND CLEARING FOR HUNTING	15%
OTHER	4%



Lesson 1: The Fire Triangle and What Fire Needs to Burn

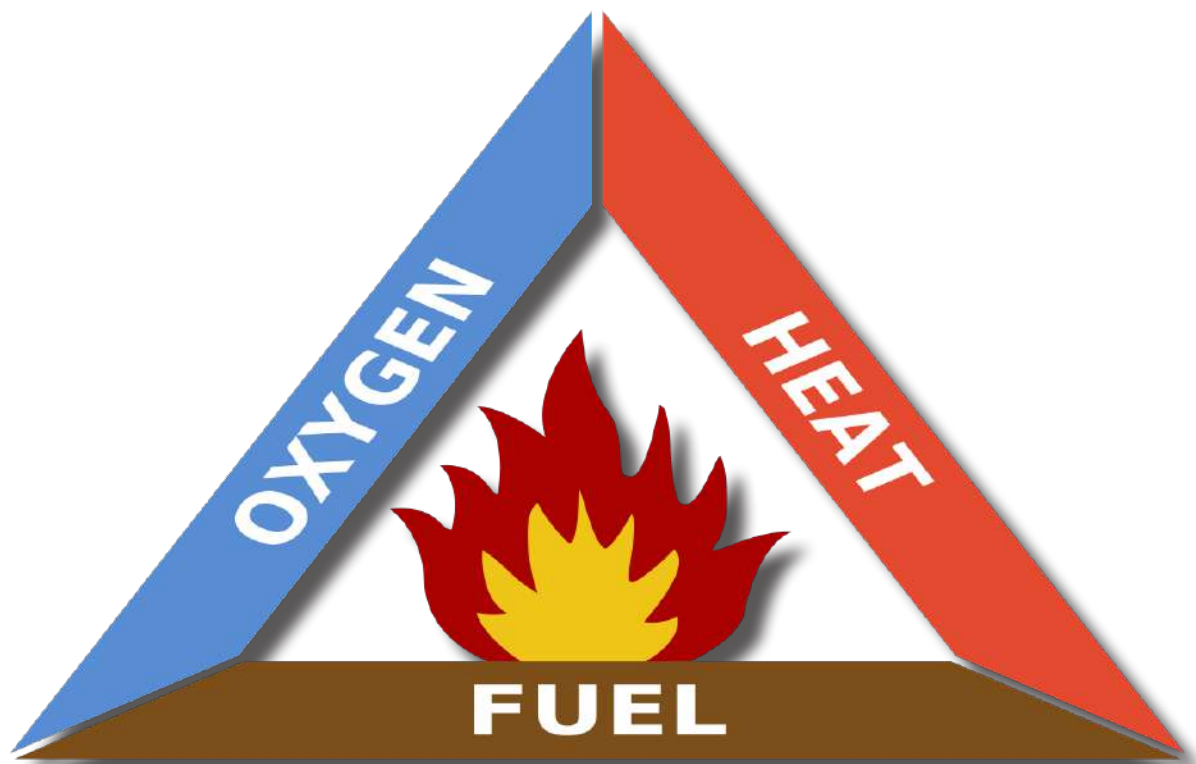


PHOTO SOURCE: [HTTPS://EN.WIKIPEDIA.ORG/WIKI/FIRE_TRIANGLE#/MEDIA/FILE:FIRE_TRIANGLE.SVG](https://en.wikipedia.org/wiki/Fire_triangle#/media/File:Fire_triangle.svg)

Learning Objectives

Knowledge

Learners will know that:

- Fire needs three elements to exist.
- If one element is not present then the fire cannot start.
- If one element is removed the fire will be extinguished.

Behavior

Learners will:

- Be able to identify ways of preventing a fire from starting.

Materials/Resources:

- Student workbooks or paper
- Pens, pencils or markers
- Whiteboard, Smartboard or poster paper
- Appropriate markers to record on the medium/s used
- Handout-worksheet for recording student responses.
- Paper
- Matches or lighter
- Fireproof tray
- Bucket of water
- 4 jars different sizes
- 4 Tea light candles
- Stopwatch

Procedure

Part 1:

Brainstorm: What does a fire needs to ignite?

Key ideas:

- Something that burns
- Dry flammable material
- Sparks, or a match
- Air and flames
- Fires are not to be left unattended.
- Record ideas discussed on a whiteboard, Smart board or poster paper are to be referred to throughout this and subsequent lessons.

Part 2:

Teacher Led Demonstration

LAB ACTIVITY 1: MAKING AND PUTTING OUT FIRE

Teacher lights a piece of paper with a match/lighter over a metal tray in a well-ventilated area. Keep a bucket of water handy. Watch the paper ignite and burn on the tray. Finally the paper smolders into ashes and the flame extinguishes itself.

Focus questions:

- How was the fire started?
- What happened when the match was removed?
- Why does the paper keep burning?
- In which direction did the flame move across the paper?
- Would the flame have moved differently across the paper if the breeze had been blowing in a different direction?
- What happened when there was no paper left to burn?
- What does fire need to burn?



Further demonstrate what happens in various scenarios:

- Part of the paper is wet
- An overturned glass is placed over the flame as the paper is burning
- Water is sprayed over the burning paper
- Compare and contrast- burning a flat paper vs. crumpled paper (less oxygen)

In each scenario, students predict what will happen before and refer to their observations after to explain what happened.

Have students write descriptions, take photos or draw 'before and after' pictures to explain:

- What happened to the paper?
- What does a fire need to ignite?
- How did the paper change?

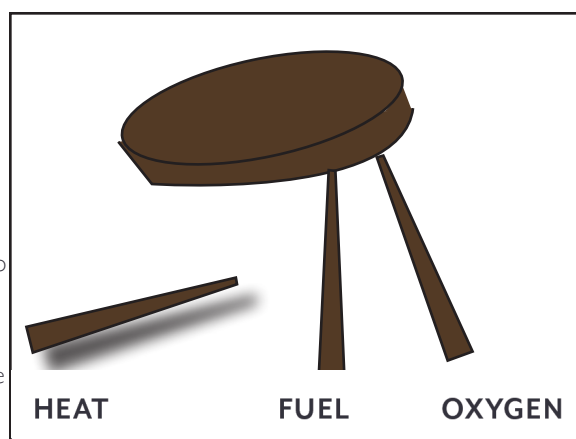
Part 3:

BACKGROUND INFORMATION

Fire requires three elements to survive (written on the stool legs – refer to the Fire Triangle):

- **Oxygen** is essential to sustain combustion (burning). Air is made up of 21% oxygen and the rest is a mixture of other gases – predominately nitrogen (78%). The last 1% is made up of water vapor, carbon dioxide and other gases. If the level of oxygen drops to 15% or less, neither people nor a fire will survive. An effective way to remove oxygen from a fire is to smother it by smothering or covering it, usually with sand or soil.
- **Heat source.** A fire needs a spark or flame to start. Fuel needs to be brought to ignition temperature for it to ignite. If the fuel drops below ignition temperature, the fire will go out. The most effective way to reduce this temperature is by cooling the fire with water.
- **Fuel or combustible material** – Dry vegetation, dry wood (furniture/house structure), paper, plastics, rubbish, etc. The most effective way of preventing a fire is by removing or reducing the fuel.

Take one of these elements away and the fire will die/be extinguished/not start.



Presentation:

Introduce the Fire Triangle (Pass out the Fire Triangle worksheet for students to take notes in).

The Fire Triangle has three essential components:

1. Fuel
2. Heat
3. Oxygen in the air

Explain their relationship to each other. Relate your explanation to Lab Activity I. Students can update their 'before and after' observations and add the correct terminology to reference the Fire Triangle.

Students relate what they discovered about fire to a bushfire and ask questions such as:

- In a bushfire what are potential fuels?
- How can those fuels ignite?
- What do firefighters do to control and extinguish a bushfire?

LAB ACTIVITY 2: CANDLE SNUFFING

Activity source: <https://www.education.com/download-pdf/activity/35962/>. Copyright © 2019 Education.com LLC All Rights Reserved

BACKGROUND INFORMATION

Oxygen: Oxygen is in the air we breathe. Humans need oxygen to keep us alive. In the same way, without oxygen, fire cannot breathe and it dies. Explain that oxygen makes up 21% of the air that we breathe. The rest of the air is made up of other gases, mainly nitrogen (78%).

Fire: A chemical reaction that creates light and heat from oxygen and fuel. A lit candle needs to draw oxygen from the air in order to continue burning. If you limit the amount of air available, the candle's flame will eventually go out once it uses up all of the oxygen.

Materials:

- Tea candle
- 4 glass jars in different sizes (make sure they're large enough to fit over the tea candle)
- Matches
- Permanent marker
- Pen or pencil
- Paper
- Stopwatch

Procedure:

1. Begin by explaining to your students that fire needs oxygen from the air in order to burn. Ask a student what she thinks will happen if you limit a candle's oxygen supply.
2. Light the candle and place one of your jars over it. Watch and wait until it goes out. Was this what he/she expected to happen? What do they think will happen if you place a larger jar over the candle? How about a smaller jar?
3. Put the jars in a row from smallest to largest, and number the jars 1, 2, 3, and 4 on the sides with permanent marker.
4. Ask students to estimate how long it will take for the candle to go out as you place each jar over it. Use the table on the following page to record their estimates.
5. Light the tea candle, and place the first jar over it. As you do so, have a volunteer student to start the stopwatch. How long does it take for the candle to go out? Record the actual time next to her estimate.
6. Repeat step four with the three remaining jars.
7. Have students compare their estimate to the actual length of time each candle burned. Were they able to predict that the candle would burn longer under larger jars? If not, point the pattern out and explain that the more air inside the jar, the longer the candle is likely to burn.



What Fire Needs to Survive Student Worksheet

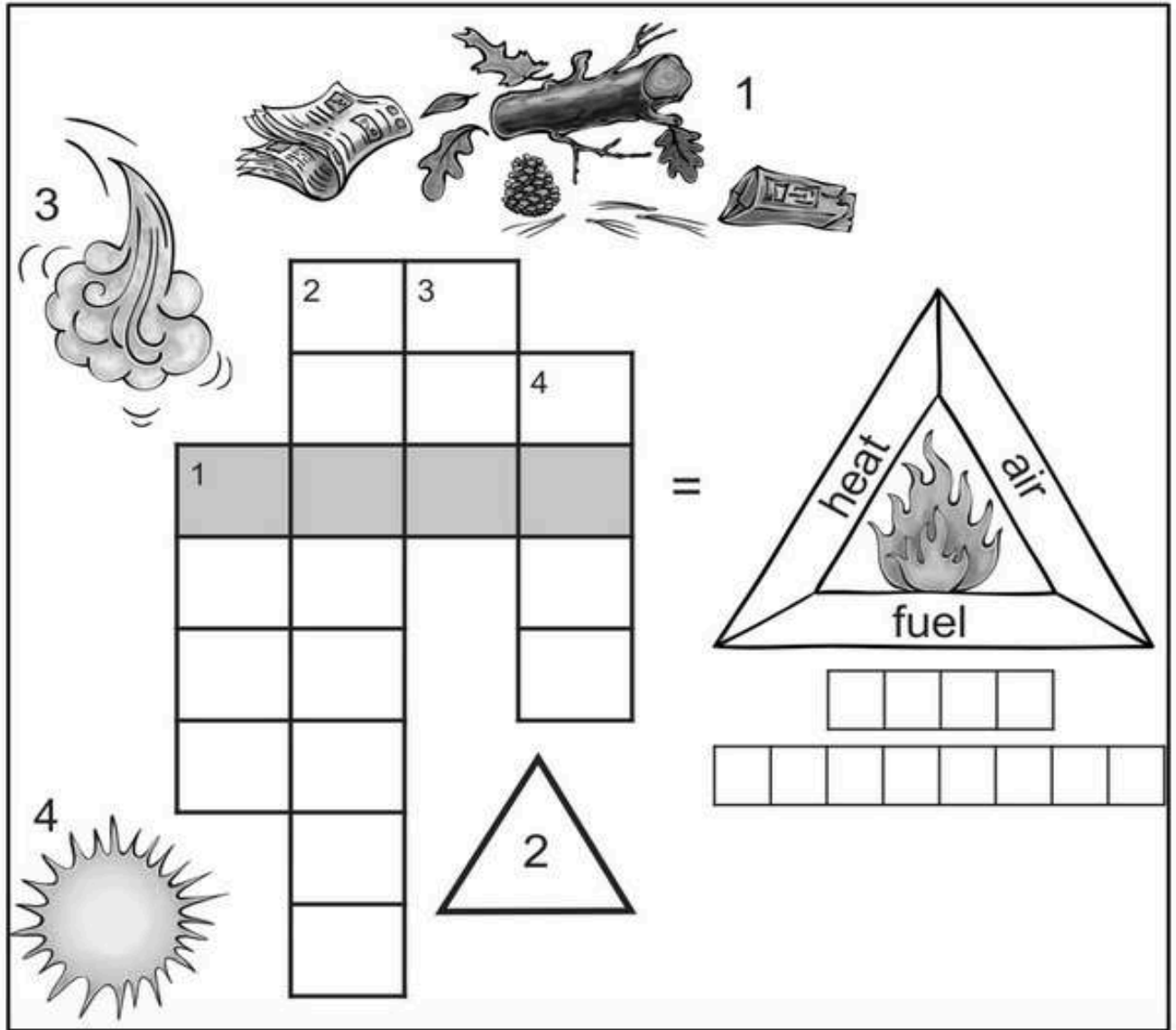


	TIME ESTIMATE	ACTUAL TIME
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		



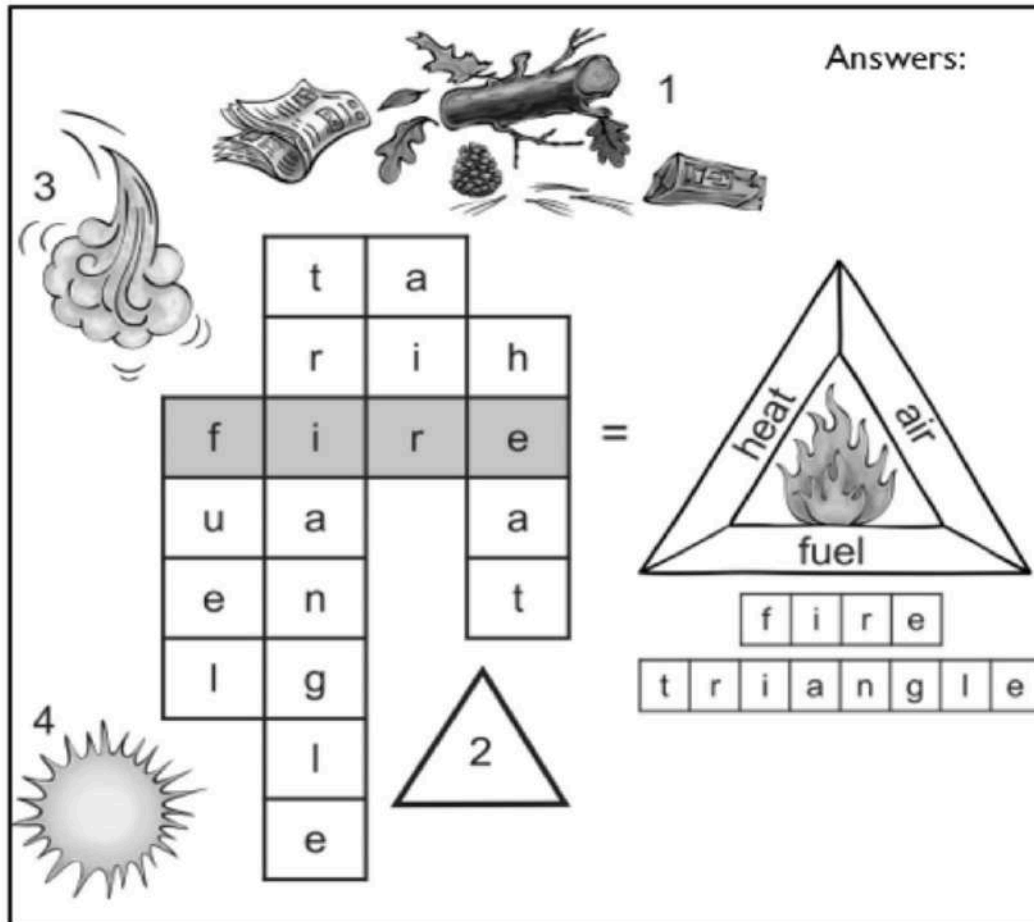
The Fire Triangle Puzzle Activity:

Fill in the words in the puzzle



The Fire Triangle Puzzle Activity:

Answer Key



LESSON 2: THE FIRE BEHAVIOR TRIANGLE

Learning Objectives

Knowledge

Learners will understand how weather, topography and fuel can influence the behavior of a fire.

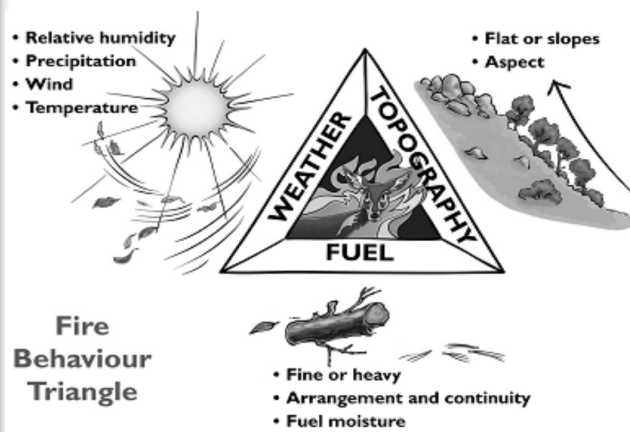
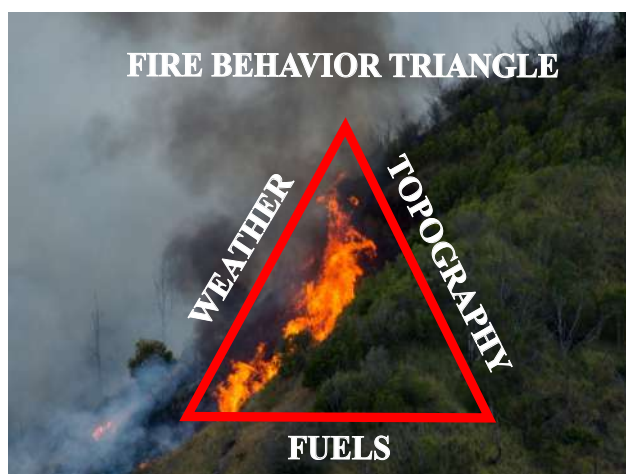
BACKGROUND INFORMATION

Environment can influence the behavior of a fire:

- Fuel: What is burning? – indigenous plants, invasive plants, dry wood/leaves/man-made fuels such as rubbish.
- Weather: Heat, wind, rain and humidity.
- Topography: Slope, aspect, relief, position on a mountain/ hill, on a plain, in a gully/valley.

Presentation

1. Do a quick recap of the fire triangle and show a picture of the broken leg stool.
2. Explain that fire also has a behavior triangle with weather, topography and fuel and this behavior triangle relates to wildfires. One side is fuel, the second side is weather, and the third is topography (terrain/lay of the land).
3. Discuss wildfire with the students.



Part 1: Fuel

Fuel: Old and dying plants are dry, contain less water and burn more easily than lush, green, moisture-filled plants.

Fuel varies in its:

- Type
- Size and Quantity
- Arrangement
- Moisture content
- If you live near a bushy area, keep a clear area of 10m between your house and the bush.

Ladder fuel – smaller bushes that act as stepping stones or ladders for the fire to move from the ground surface to the top of the trees and surrounding canopy.

- Fuel is normally classified as fine or heavy (coarse). Fine fuels such as leaves, twigs and grasses burn readily and cause spotting as the burning embers are carried through the air by the wind, starting new fires ahead of the main fire. Coarse or heavy fuels (greater than 6mm in diameter) such as sticks, branches and logs tend to ignite less readily and burn more slowly.
- It is mainly fine fuels that drive the forward spread of a fire, while the heavy fuels are consumed in the smoldering zone behind the main fire front. The fine fuel is ignited first, this heats the heavy fuel enabling it to catch alight and burn. The proportion of fine fuel verses heavy fuel affects the rate of spread and intensity of the fire. The volume/ amount of fuel affects fire behavior.
- Generally, the more fine fuel there is, the greater the rate of spread, and the greater the intensity of the fire.

LAB ACTIVITY 1: LEAF FLAMMABILITY



Objective: This lab activity determines which type of leaves (Green vs. Brown) burn faster and cleaner. The flammability of plant leaves influences the spread of fire through vegetation. In this activity students will compare fresh-leaf and dry-leaf flammability and record their times of ignition. Learning what types of materials burn and how quickly they ignite can determine what materials are better for certain applications. It is also good to know which materials to keep away from fire and heat sources in order to keep ourselves and our houses safe.

Materials:

- Outdoor grill or fire pit
- Lighter or matches
- Fresh (Green) and Dry (Brown) leaves to test for flammability
- Water for putting the fire out, just in case
- Notebook and pencil to record all observations
- Stop watch

- Adults should supervise all activities involving fire experiments

Procedure:

1. Set up the grill or fire pit in an open area on concrete, brick or asphalt, away from any low-hanging branches or leaves.
2. Place and light each bundle of leaves in turn at the bottom of the clean grill or pit. Watch whether it burns, and observe how it burns: is there black smoke? How much smoke? Does it burn quickly? Is there any smell? Does it smolder? Is there any ash or does it all burn away?
3. Time each one and record the time on the following chart showing the material tested, whether it burned, observations, time it took to burn completely-extinguish, and if there is ash.
4. Determine which Leaf material is most and least flammable. Make suggestions for applications for each material involving fire. Terms and Concepts: flammability, applications, fire safety and use.

Application: green vs brown . firefighter put it out or leave it.



TRIAL 1:

MATERIAL TESTED	TIME	OBSERVATION: 1) HOW DID IT BURN? DID IT BURN QUICKLY? 2) WAS SMOKE EMITTED? 3) WAS THERE ANY SMELL? 4) WHAT WAS THE COLOR OF THE FLAME AND SMOKE 5) IS THERE ANY ASH OR DID IT ALL BURN AWAY?
FRESH (GREEN) LEAF		
DRY (BROWN) LEAF		
MIXTURE OF BOTH		



Part 2: Weather

BACKGROUND INFORMATION

Weather – the four key elements of weather are:

1. Air Temperature
 2. Relative Humidity
 3. Wind (speed and direction) at the flaming zone of the fire; and
 4. Atmospheric Stability
- Higher temperatures normally mean that fuel pieces are warmer, drier and more easily ignited.
 - Air contains a certain amount of water vapor. Relative humidity is the measure of the water vapor content in the air as a percentage of its water vapor holding capacity at the same temperature. In the absence of rain, the amount of moisture in dead finer fuels, for example leaves, litter and grass, varies according to the relative humidity of the air.
 - On humid days (high relative humidity), fine dead fuels absorb moisture from the air and burn more slowly or may not burn at all. On dry days with low humidity levels, the air will draw moisture out of these fuels and they will ignite more easily, and will burn faster and more fiercely.
 - Wind speed is important in determining the intensity of a fire. Wind supplies oxygen for the burning process, removes ash and smoke from the area and increases the rate of burning. The stronger the wind, the more oxygen is supplied to the fire and the more smoke is removed.
 - The wind may also lift burning materials, such as bark and other embers, and carry them ahead of the main fire to start new fires.
 - Wind direction refers to the direction from which the wind is coming. A north wind comes from the north of where you are standing and travelling in a southerly direction. Sudden changes in wind direction can cause shifts in the fire front. These shifts can be particularly dangerous if they occur unexpectedly.
 - The stronger the wind blows, the faster the fire spreads. The fire generates winds of its own that are as many as 10 times faster than the ambient wind. It can even throw embers into the air and create additional fires, an occurrence called spotting. Wind can also change the direction of the fire, and gusts can raise the fire into the trees, creating a crown fire.
 - Each area has its characteristic winds. Some of these bring the hot, dry conditions that cause further problems. Other local winds may be relied upon to bring cooler, moist conditions. Generally, winds that blow from inland are hotter and drier than those which blow from the sea.

LAB ACTIVITY 2: WEATHER'S ROLE IN WILDFIRE – DATA TRACKING

Overview: Students will collect and record weather measurements for their village using weather instruments provided.

BACKGROUND INFORMATION: Weather plays a major role in the birth, growth and death of a wildfire. Drought leads to extremely favorable conditions for wildfires, and winds aid a wildfire's progress -- weather can spur the fire to move faster and engulf more land. It can also make the job of fighting the fire even more difficult. There are three weather ingredients that can affect wildfires:

- Temperature
- Wind
- Moisture

Materials:

- Notebook
- Chart Handout
- Pencil
- Weather kit:
- Humidity Tables
- Anemometer
- Psychrometer
- Compass
- Water bottle (to use in creating a wet bulb)
- Writing Board

Procedure:

Students should collect the weather data every day for a two- week period (minimum). Allow 5-10 minutes each day for the students to make and record their observations. The first day may take longer, so allow extra time. Collect the weather data using the weather instruments at the same time each day, preferably at some time between 1:00 - 3:00 pm. This is because it is generally the hottest part of the day and can then be compared accurately with data from other villages. Leave the Soil Moisture and Soil pH probe outside in a secured area to collect the daily totals. Measure the temperature using the thermometer in the shade. Record data onto data chart handout.

Discussion Questions

- Based on your data, what day had the highest Wind speed?
- Which day has the highest temperature?
- Which day was the least humid?
- How does wind speed impact the wildfire's behavior?
- How does moisture/wetness/humidity affect a wildfire?
- For the days you collected data, predict which day a wildfire would spread rapidly.
- What was the driest and windiest day?
- In a very hot, dry, and windy day, if no one ignites any fire, will a wildfire still happen? Explain.

Note: You can have the high- risk weather condition, but without an ignition source there won't be a wildfire.



Weather Instruments Background



Portable Wind meter:

An **Anemometer** is an instrument that measures wind speed and wind pressure. Hold meter at eye level, back of unit to wind. White ball in tube indicates wind speed. Meter has two scales for maximum accuracy and easy reading.

(PHOTO SOURCE: [HTTPS:// WWW.DWYER-INST.COM/PRODUCT/AIRVELOCITY/WINDMETERS/PORTABLEWINDMETER](https://www.dwyer-inst.com/product/airvelocity/windmeters/portablewindmeter))



A **Compass Rose**, sometimes called a windrose, is used to display the orientation of the cardinal direction: North, East, South, and West—and their intermediate points.



A **Psychrometer** measures the relative humidity in the atmosphere through the use of two thermometers. A dry bulb thermometer is used to measure the temperature by being exposed to the air. A wet bulb thermometer measures temperature by having the bulb dipped in a liquid. To take a reading, spin the psychrometer around in the air for 15 to 20 seconds. Then read both thermometers, reading the wet bulb thermometer first. Use the humidity table to determine humidity

(PHOTO SOURCE: [HTTPS://WWW.ENASCO.COM/P/SB51740M](https://www.enasco.com/p/sb51740m))



Rain Gauge a device for collecting and measuring the amount of rain which falls.

(PHOTO SOURCE: [HTTPS://WWW.HOMEDEPOT.COM/P/ACURITE-5-IN-GLASS-RAIN-GAUGE-00866HDSB/303046920](https://www.homedepot.com/p/acurite-5-in-glass-rain-gauge-00866hdsb/303046920))

Part 3: Topography

BACKGROUND INFORMATION

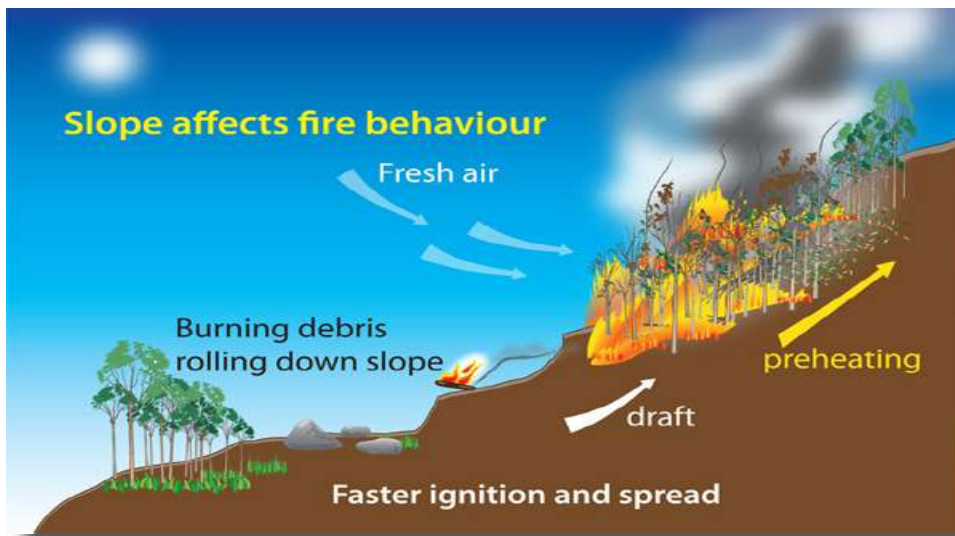
Topography describes the lay of the land and affects the direction in which and speed at which a fire will travel.

If a fire is travelling up a slope, there will be a shorter distance for radiant heat to travel from the flames to unburnt fuel.

Upslope fuels are heated by the fire coming up the slope, reaching their ignition temperature more quickly.

Fire tends to burn faster uphill than downhill.

Topography also has a major effect on the spread of wildfire. The contours, elevation and slope of an area influence temperature and wind conditions. Barriers within the landscape, such as boulders, rocks, cliffs and bodies of water, help determine how a wildfire may spread. Elevation affects the wind and moisture in an area. The steepness of a slope is directly related to the speed with which a fire spreads. If a fire begins at the bottom of a steep slope, the fuel above the fire is preheated by the flames below. Therefore, when the flames reach the higher areas, the fuel catches fire more quickly.



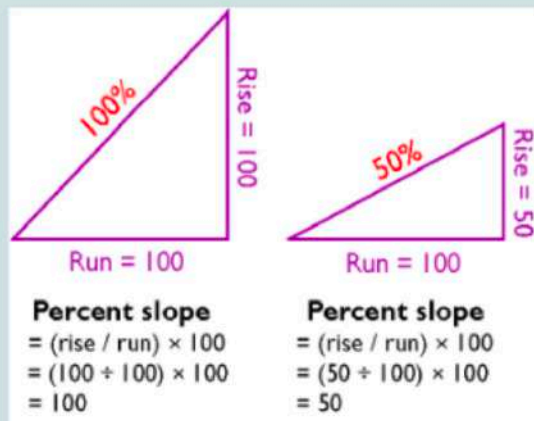
What is Slope (for the ground)?

The **ratio** of height to length (rise/run) of two points on a slanted surface.

For today we will find slope in **Percent** form.

$$\text{Slope} = \frac{\text{Height}}{\text{Length}} \times 100$$

(Rise) (Run)



LAB ACTIVITY 3: MATCHSTICK SAVANNA



Learning Objectives:

Understand how the difference in slopes affects the movement of wildfire

Resources:

- Student Handout 1: Lab sheet
- Clipboards (if you plan to have the students complete the whole lab outside)

*Note: Using photos and videos, the lab portion can be done in the classroom as opposed to in person if safety, location, funding for supplies, or student age level are a concern.

Materials

- Cardboard
- Tin container
- Matchstick
- Foil,
- Sharpie (poker)
- Cookie sheet
- Dough or Modeling Clay

Set-Up:

1. On each of the pieces of cardboard (cookie sheet) draw a 8" x 8" square with a sharpie. Then cover these squares with a layer of clay or playdough (foil) thick enough to stick a match into.
2. Three of the sheets will be used to represent a historic forest at slopes of 0°, 40°, and 90°. The fourth will be used to represent savanna.

3. In the trays representing the savanna place about 20 matches total in well-spaced clumps to mimic the forests. In the other three trays space the matches approximately one-half inch apart from each other and fill the entire 8" x 8" square (6 matchsticks in 3 inches)



Procedures

Part 1: Introduction (5 minutes)

- Start the lesson off by having the students recall the 3 essential parts of a flame and of a wildfire (oxygen, fuel, and heat.) Then explain that today they will be investigating 2 essential elements of a wildfire, fuel, and topography.
- Pass out Student Handout 1. Have the students write down their observations.

Part 2: Matchstick Savanna Activity (30-40 minutes, will be shorter if only showing videos)

- Have the students record their hypothesis about what will happen. Be sure to discuss what variable you want them to pay attention to so they are observing what you want them to see. Then light the trees (matchsticks) or show the video of the experiment. Have the students observe the results and then write them down on their lab sheet.
- The students will then repeat this process for the other three scenarios (forest at 0°, 40°, and 90° slope). You can also have them write down in their conclusions, and any errors they may have noticed in the experiments. (This portion can be done by watching the videos or the instructor performing each experiment. At the discretion of the instructor, the students can perform the experiment themselves.) Students should record qualitative and quantitative data (What area of sq. inches burned/number of matchsticks/percentage of forest burned)? Was there wind? Were there differences in the matches (trees)? How quickly did the fire spread?
- Students will analyze their data and explain whether their hypothesis was supported or not supported. They will explain why based on their qualitative and quantitative data.

LESSON 3: THE FIRE REGIME

LEARNING OBJECTIVES

Knowledge

Learners will:

Understand how the climate, ignition and vegetation can influence the behavior of a fire.

BACKGROUND INFORMATION

Fire Regime: Refers to the patterns of fire that happen across a landscape or region over time. Fire regimes differ across the world depending on the pattern of ignition sources, the vegetation or fuel type, and longer term climate trends like seasonal changes in temperature and rainfall.

Ecologists can define this in many ways, but one way is through an estimate of plant mortality. Fire can burn at **three levels**:

1. Ground fires will burn through soil that is rich in organic matter.
2. Surface fires will burn through dead plant material that is lying on the ground.
3. Crown fires will burn in the tops of shrubs and trees.

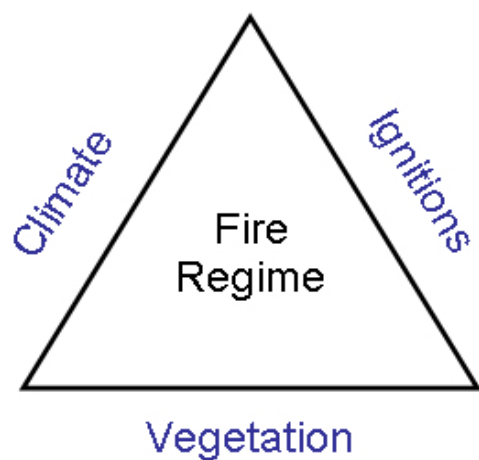


Photo Source: https://www.researchgate.net/figure/Controls-on-a-fire-regime-The-vegetation-axis-incorporates-fire-related-characteristics_fig4_228900673

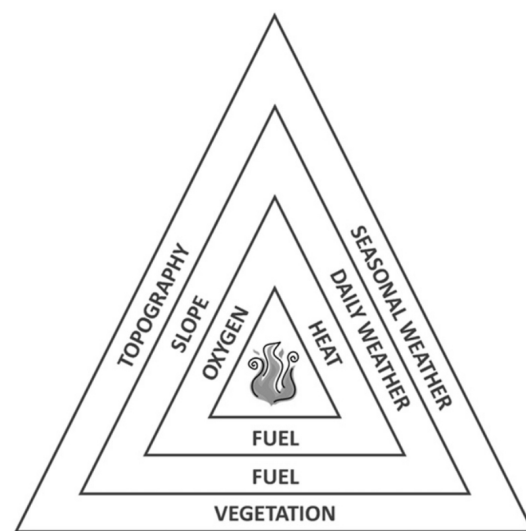


Diagram source: Keane, R.E. 2015. Wildland fuel fundamentals and applications. New York, NY: Springer.

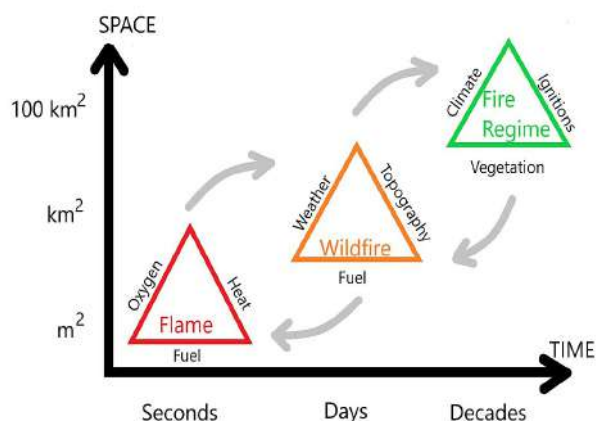


Photo source: https://www.wikiwand.com/en/Fire_triangle



Fires will often break out during a dry season, but in some areas, wildfires may also commonly occur during a time of year when lightning is prevalent. The frequency over a span of years at which fire will occur at a particular location is a measure of how common wildfires are in a given ecosystem. It is either defined as the average interval between fires at a given site, or the average interval between fires in an equivalent specified area.

Knowing the Fire Regime triangle is also important to understand how we can take actions to reduce fire risk. People can work to reduce the number of ignitions, through fire prevention outreach and education. Changing the vegetation or ecosystem can also reduce fire risk. Many projects across the Pacific Islands are regrowing forests in savanna areas to reduce the risk of fire. If these forest restoration areas can be cared for and protected, over time the trees can overtop and shade out savanna grasses and ferns and increase moisture in the soil and understory vegetation. By intentionally changing vegetation from savanna to forest over large land areas, people can change the fire regime and reduce the risk of fire. Finally, we must recognize that increasing temperatures globally are already making the world more prone to fire. The science of fire regimes teaches us that fire is one of the few climate-related challenges over which we can exert some local influence to minimize the impacts. In this way, fire management holds important lessons for tackling climate change more broadly.



Worksheet Assignment: 1

Directions: Using the following information provided by the Annual summary report below for the Western Pacific Answer the questions on the next page.

2018 Western Pacific Wildfires | PFX Annual Summary

This annual summary aims to provide a sense of context for wildfire activity on the Western US-Affiliated Pacific Islands (USAPI) of Palau, Guam, the Northern Marianas, and Yap where fires are most frequent, due to annual dry seasons (Dec/Jan to May). However, fires can have severe impacts across all the USAPI during intense drought. Fire is a key threat to communities and native ecosystems on Pacific Islands. Fires also increase sediment run-off to nearshore coral reefs and protecting marine ecosystems is a key goal of fire management for the entire Pacific region. For a more detailed discussion visit www.PacificFireExchange.org.

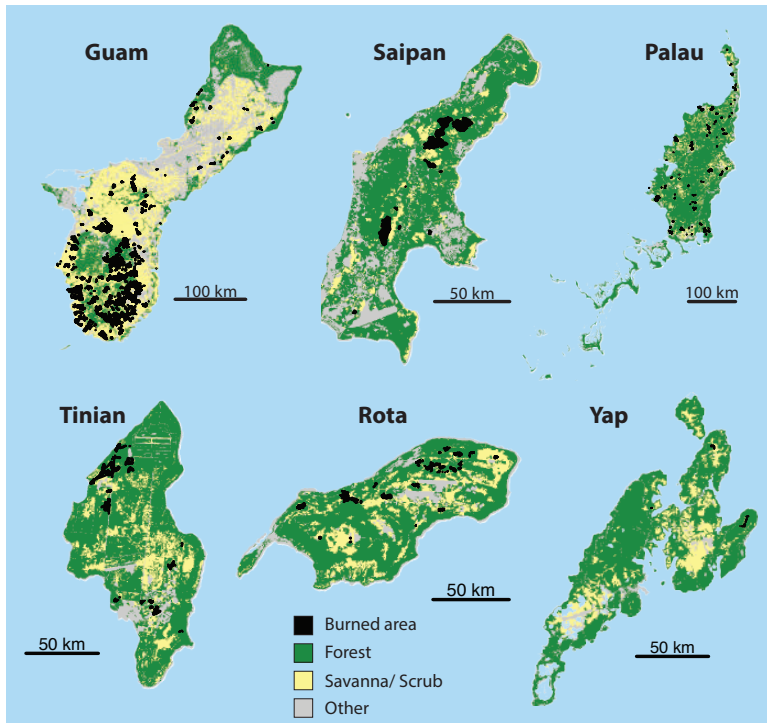


Figure 1. Island land cover, with areas burned by fires in 2018 indicated in black. Land cover data from LANDFIRE.

Land Cover Pacific Island fires are largest and most frequent in open savanna vegetation, but large areas of forest edges are exposed to savanna fires each year. Intense fires kill trees and allow nuisance grasses to spread, increasing future fire risk.

In 2018, 77% to 87% of the area burned on Guam, Saipan, and Palau occurred in savannas, which much of the remaining area in nonnative forest (e.g., *Leucaena leucocephala*, *Tanganyika*). However, burned areas overlapped with native forest for 69 acres on Palau, 42 acres on Rota, and 290 acres on Guam. Field surveys are needed to confirm impacts to these areas.

Weather Rainfall on Saipan and Tinian was well below average coming into the 2018 dry season, contributing to numerous grass fires. Yap had a very rainy dry season, which limited fire activity. For Guam, 2017 and 2018 were wetter than average, likely increasing fuel loads.

Typhoons Mangkhut in September and Yutu in October passed over the Marianas, causing severe damage and heavy precipitation. The rains lowered fire risk in the short term, but excess grass growth and downed trees and debris will increase fuel loads for the 2018-2019 dry season.

Island	Number of Fires	Acres Burned	Island Area Burned
Guam	468	6,251	4.7%
Annual Avg	672	4,715	3.5%
Rota	35	275	1.3%
	54	502	2.4%
Tinian	41	495	2.0%
	33	463	1.9%
Saipan	14	726	2.5%
	22	460	1.6%
Palau	137	666	0.6%
	173	724	0.6%
Yap	7	5	0.1%
	36	528	2.1%

Table 1. Data for 2018 in **bold**, annual averages in lighter font. Fire information is limited in the USAPI. Defining 'average' fire activity is difficult for some islands and continued record-keeping is critical. Guam has 27 years of fire data, Yap and Palau both have 7 years, and Rota, Tinian, and Saipan each have 3 years.

Wildfire Incidents

Guam had fewer fires but more area burned (>6,000 acres) than usual.

Palau had fewer fires and less area burned than average.

Yap was unusually wet in 2018 and saw only 7 fires burning a small fraction of the annual average.

Rota, Tinian and Saipan all had active fire years, however, longer term data is required to identify any trends.

Management Activities A range of activities in 2018 sought to address fire risk. Vegetation management on Guam included removing dead trees and ladder fuels to reduce fire damage to forests and create safer conditions for firefighters. Ongoing 'greenbelt' reforestation and fuelbreaks on Guam and Yap are being established to slow savanna fires. In March, the CNMI Department of Fire and Emergency Medical Services partnered with Tinian's Department of Public Works to create fire breaks around residences vulnerable to wildfire. Rota maintained fire lanes and hydrants, and, for the past two years has limited access to the most fire-prone areas, resulting in a decrease of both ignitions and area burned. Public education and outreach, including school presentation programs, remains active across the region.

Thanks to Christine Camacho-Fejeran, Susan Cordell, Julian Dendy, JB Friday, and CNMI Department of Fire and Emergency Medical Services. Data: Guam Forestry & Soil Resources Division, Guam Fire Department, National Park Service, Coral Reef Research Foundation, and US Forest Service. Analysis: Clay Trauernicht, University of Hawaii at Manoa Wildfire Extension. Layout & Design: Melissa Kunz, Hawaii Wildfire Management Organization



1. What was the number of fires reported for Palau in 2018? _____
2. What is Palau's Annual Average for number of fires. _____
3. Which Island had the least fire in 2018? _____
4. Based on the wildfire incident statement why did that island (question 3) have the least fire?____

5. How many acres of Palau's land did wildfire burn? _____
6. Was that more or less than the number of fires that occurred?
7. What management activities in 2018 were implemented to address fire risk in Palau?
8. Why do you think Public outreach and awareness programs for the Pacific were considered one of the Management activities?
9. How will you involve yourself and your class in being part of this Fire risk management activity?

LAB ACTIVITY 4: MANAGEMENT ACTIVITIES

1.) REMOVING DEAD TREES AND LADDER FUELS TO REDUCE RE DAMAGE TO FORESTS AND CREATE SAFER CONDITIONS FOR FIREFIGHTERS.



2.) 'GREENBELT' REFORESTATION AND FUEL BREAKS



3.) CREATE FIRE BREAKS AROUND RESIDENCES VULNERABLE TO WILDFIRE.



4.) LIMITED ACCESS TO THE MOST RE-PRONE AREAS, RESULTING IN A DECREASE OF BOTH IGNITIONS AND AREA BURNED.



5.) WILDFIRE AWARENESS IN PUBLIC EDUCATION AND OUTREACH, INCLUDING SCHOOL PRESENTATION PROGRAMS WITH FORESTRY DIVISION,



Unit 3- Ridge to Reef

In this Unit students will create solutions to prevent wildfires which will help protect our natural resources from the ridge to the reef. They will learn the different roles that government and nongovernment organizations play in managing our natural resources.

	LESSON	OBJECTIVES	NGSS STANDARDS
Lesson 01	Introducing Natural Resources	Student will: <ul style="list-style-type: none"> List the natural resources on Palau Explain the importance of different natural resources List the different agencies that help manage Palau's natural resources Create solutions to help prevent wildfires Differentiate between managed and unmanaged fires Identify native plants that will be used in the reforestation project 	NGSS- Middle School: <u>MS-ESS3-3</u> : Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. <u>MS-LS2-5</u> : Evaluate competing design solutions for maintaining biodiversity and ecosystem services
Lesson 02	Wildfires and their impacts		

Essential Questions

- What ecosystems of Palau are affected by wildfires?
- Who manages and protects our natural resources?
- What natural resources do we depend in in Palau?
- How am I affected by wildfires?
- What are solutions to helo prevent wildfires?

Anticipatory Set

Quick write: Student will have a quick write explaining how wildfires affect them. (Expect to support some students who are unable to list down ways that they are affected by wildfires.)

Example list of ways fires affect us.

- Erosion
- Water quality
- Safety
- Health
- Economic
- Native Species
- Endemic Species
- Endangered Species
- Criminal Activity
- Food and farms
- Biodiversity

VOCABULARY

Natural Resources:

materials or substances such as minerals, forests, water, and fertile land that occur in nature and can be used for economic gain

Runoff:

the draining away of water (or substances carried in it) from the surface of an area of land, a building or structure, etc.

Ecosystems: a biological community of interacting organisms and their physical environment

Endemic Species: native and restricted to a certain place

Endangered: a species of animal or plant that is seriously at risk of extinction

Watershed: an area or ridge of land that separates waters flowing to different rivers, basins, or seas.

Erosion: the action of surface processes (such as water flow or wind) that removes soil, rock, or dissolved material from one location on the Earth's crust, and then transports it to another location

Sedimentation:

The process of particles settling to the bottom of a body of water



Lesson 1: Introducing Natural Resources

What is an ecosystem? What happens to ecosystems during disturbances?

Teacher will lead a discussion on natural resources.

Opening question: What are natural resources? Teacher lists the answers on the board.

Examples:

- Water
- Trees
- Marine life
- Soil

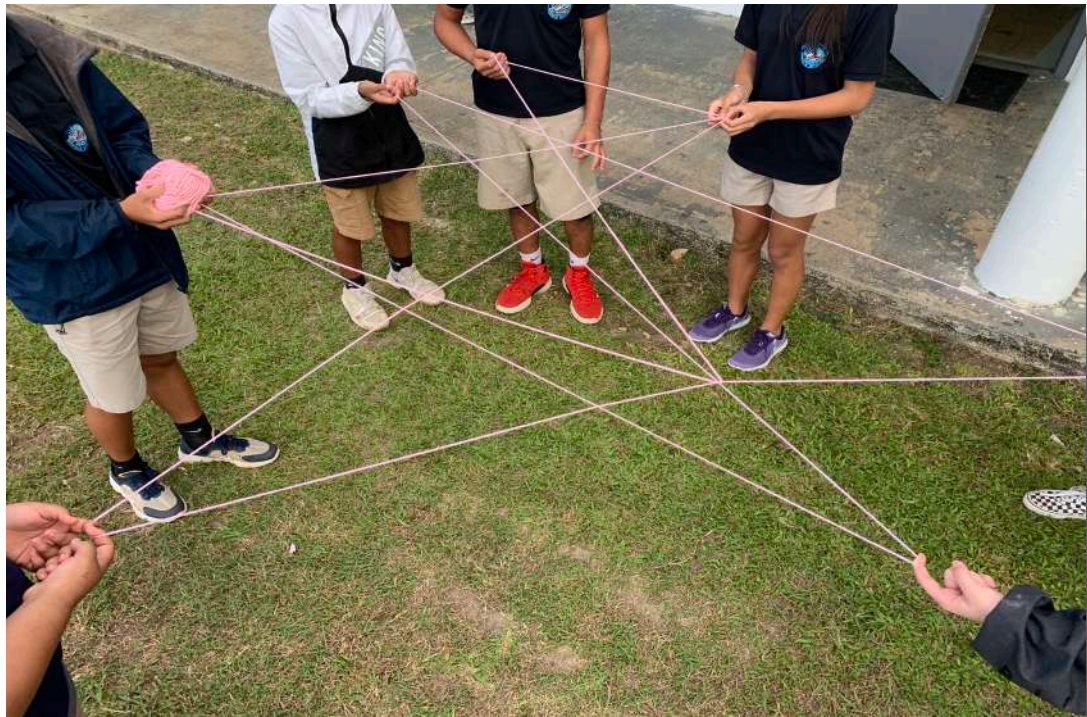
Follow up questions: What natural resources do we depend on in Palau? The answers may be similar to the first list.

Activity to support the learning: Foldable (interactive notebook)

Students will create a foldable that will be inserted into their science notebook. See directions at the end of this lesson.

What happens to ecosystems during disturbances? (Wildfire, typhoons, drought etc)

Yarn activity



Ecosystem: a biological community of interacting organisms and their physical environment.

Introduction

In this activity the teacher will introduce ecosystems and what makes up ecosystems. After the introduction the students will use a ball of yarn to learn about ecosystems and the interactions between living and non-living organisms and the shifts in an ecosystem when things are added or taken away from the system. Finally the students will be able see how activities on land affect the sea (ridge to reef). This activity is designed to provide both visual and tactile demonstrations of the interconnectedness of all components of an ecosystem, and that they are dependent on each other for survival.

Estimated Time : 15-20 minutes

Materials

- Ball of yarn
- Activity sheet (pictures of plants and animals)
- Tape or paper clips to attach pictures to the students' clothing
- Space for the class to get into two circles

Background

What is an ecosystem? An ecosystem is the community of living (biotic) organisms with non-living (abiotic) factors as they exist in their natural environment. Natural environments include things like water, soil and air. An ecosystem can be anything small space where an organism lives to a huge place such as the wilds of Africa: (<https://www.educationquizzes.com/us/middle-school-6th-7th-and-8th-grade/science/ecosystem/>)

Examples of Biotic and Abiotic Factors

- Biotic- Plants, Animals, Bacteria, and Fungi
- Abiotic- Water, Non-living parts of Soil, Air, Sunlight, Minerals

An ecosystem may have some sort of shift when something is added to or taken out of the system. In this activity we want to put an emphasis on what happens to an ecosystem when disasters occur especially wildfires.

When disturbance happens to an ecosystem on land the effects can be felt in the ocean. Example: After a wildfire occurs the plants that hold the soil together are burnt to the ground which causes the land to be bare soil. When heavy rain falls, topsoil starts to erode away and wash into the river. The soil then makes its way to the ocean via rivers which causes sediment to then blanket the coral reef. The corals house symbiotic algae that need sunlight to photosynthesize. If the reef is covered with sediment from land, then algae would have a difficult time capturing the sunlight needed for photosynthesis. This is a key example that shows how wildfire affects the ridge and the reef. Multiple ecosystems are affected by wildfires.

Activity: Modeling a Food Web

Cut out activity sheets- Have students tape or clip one picture each to their shirts.

1. Have students stand in a circle either in the classroom, or outside. Explain to the students that they are going to create an ecosystem. Students can pass the ball of yarn to any student who has a picture that is connected to their own picture in an ecosystem. For example:

Student 1: "I have the Sun, and I will pass the yarn to

Student 2 because s/he has a tree and the tree needs the sunlight to make food."

Student 2 : "I have a tree, and I will pass the yarn to

Student 3 because s/he eats the fruit of the tree."

Student 3 : "I have worm, and I will pass the yarn to

Student 4, because....."



2. Position the student with the sun in the middle and have everyone else make a circle around this student.
3. Now give the student with the sun the ball of yarn. The student with the sun will hold onto the loose end and pass the yarn to a student that uses the sun to get energy (plant). The student with the ball of yarn will pass it to the next person that consumes that plant. As the students pass the ball back and forth they will hold on to the string and pass the ball, which will start to create a web between them. After the students finish the first web, give the Sun back the ball of yarn and they will again pass the yarn to another student with a picture of plant. Continue until everyone is connected.
4. Start the discussion of how each organism is dependent on each other and the Sun.
 - a. What happens if a natural disaster hits and the mango tree is destroyed?: Everyone that is connected to the mango tree is now affected.
 - b. Continue to come up with other scenarios asking what happens to the system when something is added to the system or taken out of the system.
5. Now the teacher can ask the students: “Does what we do on land affect the ocean?” Depending on their prior knowledge, the answers may vary. The teacher now starts to steer the students in the right direction by asking what happens to the system if a wildfire were to occur.
 - a. What happens to the system if a wild fire occurs? Who is affected? Some student responses may include:
 - The plants would burn and die.
 - The organisms that depend on the plants will not have food.
 - Nothing will happen.
 - b. If the plants burn and die what would happen to the soil during heavy rain? The soil would run off of the land because there are no plants to hold the soil in place and absorb the water. Then the soil would end up in the ocean as sediment. This sediment would blanket the surrounding reef, not allowing the sun to penetrate. When the algae are not able to get sunlight, they will start to die like plants on land. The fish that feed on the algae will then lose food and the domino effect continues. This is how the ecosystem in the ocean could be affected because of the wildfire on land.
 - c. Questions at the end of the activity.
 - What is in the center of the food web (ecosystem)?
 - What are some disturbances that could shift the system?
 - What one way activity on land could affect the ecosystems in the ocean?

What happens to ecosystems during disturbances? (Wildfire, typhoons, drought etc)

Teacher prepares pictures of wildfires, erosion, sediment smothering the reef, loss of habitat, shift in the system.

Teacher asks: what are disturbances to ecosystems?

List the answers: Wildfire, typhoons, drought, etc














Teacher can show the pictures and students can explain.
















ECOSYSTEM SERVICE EXERCISE

THE NEXT EXERCISE WILL ALLOW STUDENTS TO CONNECT THE VARIOUS PLANT AND ANIMAL SPECIES TO THE ECOSYSTEM SERVICE THEY PROVIDE IN A FOREST IN ORDER TO BE ABLE TO PROJECT THE CONSEQUENCES OF LOSING BIODIVERSITY IN A FOREST. AT THE SAME TIME STUDENTS WILL LEARN THE CULTURAL SERVICE PROVIDED BY THE FOREST TO HUMANS.

LOOK AT THE SYMBOLS OF PLANTS AND ANIMALS BELOW AND IDENTIFY THE CORRECT ECOSYSTEM SERVICE FROM THE WORD LIST AND WRITE ON THE LINE.

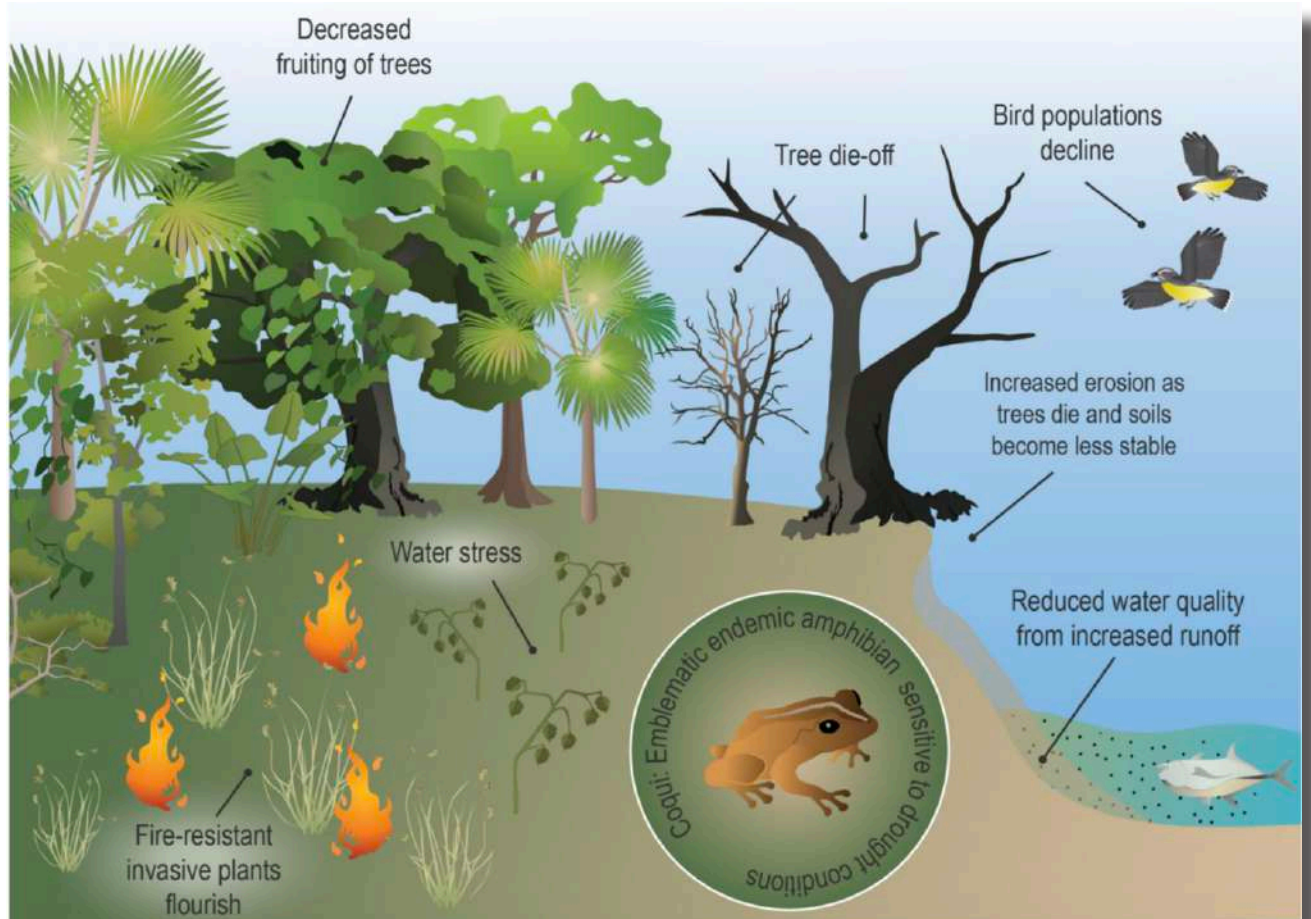
			<u>Ecosystem service</u> Bug control Soil creation Pollination Plant propagation Shelter Food Water filter Temperature control	
				
				
				

LOOK AT THE SYMBOLS FOR PLANTS AND ANIMALS BELOW AND CHOOSE THE CORRECT CULTURAL SERVICE FROM THE WORD LIST ON THE RIGHT AND WRITE UNDERNEATH EACH PLANT OR ANIMAL.

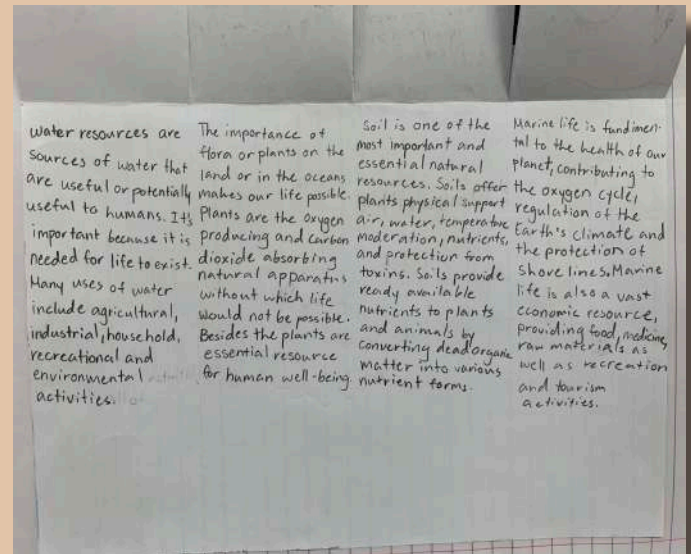
			<u>Cultural Service</u> Symbol of time Broom Good luck Food Storm signal Bait Shelter Oil Medicine Simbol of good parent Show rotten trees not good for canoe or house	
				
				
				

ECOSYSTEM SERVICE EXERCISE CONTINUED

THE PICTURE BELOW DEMONSTRATES THE PROGRESS OF BIODIVERSITY AND ECOSYSTEM SERVICE LOSS AS A RESULT OF WILDFIRE.



Activity- Foldable Interactive Notebook



Materials:

1. Blank 8.5" x 11" paper, one sheet per student
2. Pens, markers, colored pencils or crayons
3. Glue

Instructions:

1. Fold your paper in half short ways (hamburger style)
2. Title it "Natural Resources" on the top of the page
3. Divide the front into 4 equal parts. Each of the 4 sections will be a resource.
4. Title each resource, and draw a picture of it.
5. On the inside of each tab, describe why each resource is important.
6. Cut along each line so that you can lift the tabs.
7. Have students glue the foldable into their notebooks.

Color pencils



Yarn Activity Cards

MANGO TREE

MANGIFERA INDICA



MICRONESIAN STARLING

APONIS OPACA



FRUIT FLY

DROSOPHILA MELANOGASTER



BROWN TREE SNAKE

BOIGA IRREGULARIS



ISAAC CHELLEMAN

Yarn Activity Cards

MOURNING GECKO

LEPIDODACTYLUS LUGUBRIS



FLAME TREE

DELONIX REGIA



CHICKEN

GALUS GALLUS DOMESTICUS



LOOPER

PERICYMA CRUEGERI



Yarn Activity Cards

MARIANA EIGHT-SPOT BUTTERFLY

HYPOLIMNAS OCTOCULA MERIANENSIS



PACIFIC BLUE SKINK

EMOIA CAERULEOCAUDA



RED ALGAE

GRACILARIA TSUDAE



TATAGA' OR BLUESPINE UNICORNFISH

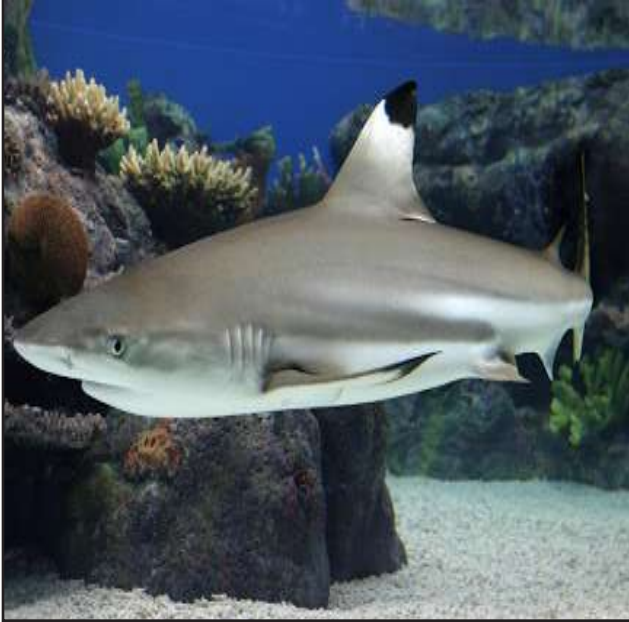
NASO UNICORNIS



Yarn Activity Cards

BLACKTIP REEF SHARKS

CARCHARHINUS MELANOPTERUS



SUN

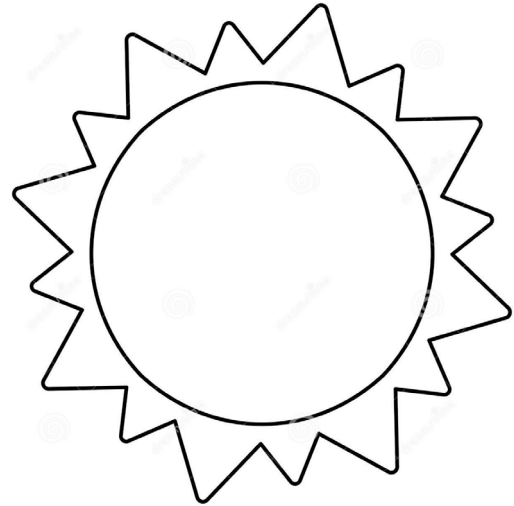


PHOTO SOURCES

MICRONESIAN STARLING: [HTTPS://WWW.GUAMPEDIA.COM/A-NATIVE-FOREST-BIRDS-OF-GUAM/](https://www.guampedia.com/a-native-forest-birds-of-guam/)

FLAME TREE: [HTTPS://GUAM.STRIPES.COM/COMMUNITY-NEWS/COME-BLOOM-FLORA-GUAM](https://guam.stripes.com/community-news/come-bloom-flora-guam)

LOOPER: [HTTPS://WWW.WHATSTHATBUG.COM/2013/11/11/UNKNOWN-CATERPILLARS-GUAM/](https://www.whatsthatbug.com/2013/11/11/unknown-caterpillars-guam/)

BUTTERFLY: [HTTPS://WWW.POSTGUAM.COM/NEWS/CNMI/DESTRUCTIVE-CATERPILLARS-THREATEN-SAIPAN-S-FLAME-TREES/ARTICLE_36B20D3A-ABC8-11E6-A2C1-67D59D4E4A30.HTML](https://www.postguam.com/news/cnmi/destructive-caterpillars-threaten-saipan-s-flame-trees/article_36b20d3a-abc8-11e6-a2c1-67d59d4e4a30.html)

8-SPOT BUTTERFLY: [HTTPS://WWW.FWS.GOV/NWRS/THREECOLUMN.ASPX?ID=2147615276](https://www.fws.gov/nwrs/threecolumn.aspx?id=2147615276)

BLUE TAILED SKINK: [HTTP://ELIJAHWOSTL.WEEBLY.COM/EMOIA-CAERULEOCAUDA.HTML](http://elijahwostl.weebly.com/emoia-caeruleocauda.html)

BROWN TREE SNAKE: [HTTPS://WWW.GUAMPEDIA.COM/BROWN-TREESNAKE/](https://www.guampedia.com/brown-treesnake/)

MOURNING GECKO: [HTTP://ELIJAHWOSTL.WEEBLY.COM/LEPIDODACTYLUS-LUGUBRIS.HTML](http://elijahwostl.weebly.com/lepidodactylus-lugubris.html)

BLUESPINE UNICORNFISH: [HTTPS://WWW.FISHERIES.NOAA.GOV/FEATURE-STORY/HOW-ARE-CORAL-REEF-FISH-DOING-GUAM](https://www.fisheries.noaa.gov/feature-story/how-are-coral-reef-fish-doing-guam)

BLACKTIP REEF SHARK: [HTTP://MICRONESIANCONSERVATION.ORG/JEN-PAGE-3/](http://micronesianconservation.org/jen-page-3/)

Lesson 2: Wildfires and Their Impacts, Agencies' Roles in Preventing Wildfires

What agencies help manage our natural resources? Wildfires and their impacts. Roles of the forestry wildland firefighters?

Students can research what agencies manage our natural resources on Palau for homework, or the teacher can list the agencies and based on the names of the agencies the students can guess what role or resource each agency is in charge of.

Agencies Include:

- Palau Bureau of Agriculture:
 - Division of Forestry
 - Division of Horticulture and Extension
 - Division of Biosecurity
 - Division of Livestock
- Palau Division of Fire and Rescue
- Palau Environmental Quality Protection Board
- Palau Division of Fish and Wildlife
- Palau Protected Areas Network
- Palau Wildfire Prevention Network



Teacher leads a discussion on what is wildfire, listing the answers on the board. Teacher asks students: "What are the impacts of wildfires?"

Examples:

- Loss of trees holding the soil leading to erosion
- Erosion of soil leads to sediment smothering the reef
- Loss of trees and soil decreases water retention and increases flooding
- Health - difficulty breathing, breathing ashes into lungs
- Economic impacts - loss of work, cannot get to work

The teacher leads a discussion on: **What are agencies doing to help prevent wildfires? What can you do to help prevent wildfires?**



Unit 4- Wildfire Prevention

The purpose of this unit is for students to understand the measures that can be taken at home as well as those taken by the different agencies of Palau. Based on prior knowledge built throughout the curriculum, students will propose their own solutions for wildfire prevention. They will understand the concepts of Firewise and apply those ideas to their own homes and villages. Students will further understand the grass-fire cycle and propose long-term prevention strategies.

	LESSON	OBJECTIVES	STANDARDS
Lesson 01	Prevention vs. Suppression	Students will <ul style="list-style-type: none">Understand the difference between suppression vs preventionIdentify ignition sourcesExplain how those ignition sources can create large scale wildfiresPropose solutions to prevent wildfires	NGSS: <ul style="list-style-type: none"><u>ETS1-1</u>: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.<u>ETS1-2</u>: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.<u>ES3-3</u>: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment<u>HS-ETS1-3</u>: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impact
Lesson 02	Grass- Fire Cycle		
Lesson 03	Firewise		
Lesson 04	Service Learning Project		

Lesson 1: Prevention vs. Suppression

Overview

Students will understand why we should focus on prevention (vs suppression) of wildfires. Students will create posters that explain the major heat sources for Palau wildfires and propose solutions to eliminate those sources.

Procedures

Day 1

Teacher will ask students to answer the following review question:

- What are the 3 key components of the Fire Triangle?
- Of those components, which ones can we control?



1. Teacher will have students create a list of how wildfires start on Palau. Teacher will have students share out a class list of the major sources (examples include: trash burning, cigarettes, bonfire/bbq, arson, poaching, etc). Teacher will tell students that these are sources of heat or “ignition.”



2. Teacher will state that all wildfires on Palau are caused by humans! (*include # of fires in the last year, show pictures of burned areas*). Teacher will show the Ebiil Society Inc. Facebook post on the series of wildfires in Babeldaob in April 2019. Teacher will lead a class discussion of the following image, asking: “How big is the burned forest area?”
4. Teacher will have students create a Venn Diagram on their paper with “Suppression” on one side and “Prevention” on the other. Teacher will lead a class discussion about the difference between the two words. Students will pull out key information (can include cost, effect, techniques) and decide which side of the chart it goes on and what both sides have in common. Teacher will have students share out with the class some of the things they found to construct a class diagram (students can fill in information they missed on their personal diagram). Teacher will ask the students to think-pair-share “If you were in charge of the Forestry Division, would you focus on suppression or prevention? Why?” Teacher can probe with questions to eventually get to the fact that if you focus on prevention, it will cost less money, is less dangerous for the firefighters, etc

Focus on Prevention

5. Teacher will pass out Prevention Cards*. Teacher will tell students that each student either has a potential wildfire cause card or a solution card. They will need to find their partner. After each student has found their partner, the teacher will have students share their cause and solution with the rest of the class.
6. Teacher will have students work in groups (3-4 people). Students will pick one of the causes of fire and create a poster that they will present to the class. Their posters should include:
 - Catchy title
 - Clear explanation of the cause (make sure students note that they are all caused by humans)
 - 2 solutions to eliminate those causes
 - 3 pictures
 - Teacher will encourage students to be both creative and realistic with their solutions.

Day 2

1. Teacher will give students time to finish their posters
2. Teacher will tell students that they will be participating in a gallery walk. Teacher will place a “reflection paper” next to each poster. Teacher will instruct students that they will be moving with a group to visit each poster. Groups will have 3-4 minutes to observe posters. Each group member will take turns leaving feedback on the posters. Teacher will project the following feedback questions on the board for students to respond on each of the groups’ “reflection papers”.
 - What did you learn from this poster?
 - What surprised you on this topic?
 - What is one extension question you have about this topic?
 - How can people benefit from this solution?
 - How can animals and the environment benefit from this solution?
 - What is another alternative solution for this cause?
3. Future Makers: Teacher will have students answer the following prompt: What is one major takeaway you have from today’s lesson? How can you spread this information to your friends, family, and community?



Supplemental Resources for Posters:

- Trash Burning Permit: <https://www.palaugov.pw/wp-content/uploads/2017/05/Open-Burning-App.pdf>

Sources:

*Prevention Game Cards: Lesson adapted from Know Fire (Hawaii Wildfire Management Organization)

Cause & Prevention Cards

CAUSE:

A FIRE STARTS IN A LARGE AREA OF TALL GRASSES ON GOVERNMENT LAND. IT IS ABOUT HALF A MILE FROM A LOCAL SCHOOL AND VILLAGE AND NOW THE PEOPLE IN THAT AREA ARE IN DANGER.

PREVENTION:

I CAN VOLUNTEER WITH THE FORESTRY DEPARTMENT TO CREATE FIRE BREAKS (AN AREA OF LAND WHERE THE PLANTS ARE REMOVED AND IT IS JUST BARE SOIL) SO IF THERE IS A FIRE, THE FIREBREAK WILL STOP THE FIRE FROM REACHING THE VILLAGE OR SCHOOL.

CAUSE:

I WAS BURNING TRASH IN MY BACKYARD ON A WINDY DAY AND AN EMBER BLEW FROM THE BURNING AREA AND CAUGHT THE EMPTY FIELD NEXT TO MY HOUSE ON FIRE.

PREVENTION:

I SHOULD HAVE GOTTEN A BURN PERMIT FROM THE MAYOR OF MY VILLAGE AND I SHOULD ONLY BURN IN MY BACKYARD DURING APPROPRIATE WEATHER CONDITIONS.

CAUSE:

A FARMER STARTS A FIRE TO CLEAR OUT FARMLAND SO HE CAN PLANT NEW CROPS.

PREVENTION:

I CAN HELP THE FARMER REMOVE THE OLD CROPS BY HAND OR WITH OTHER TOOLS.

CAUSE:

POACHERS SET AN INTENTIONAL FIRE TO DRAW ANIMALS OUT AND MAKE IT EASY TO HUNT THEM. THE FIRE GOT OUT OF HAND AND MOVED CLOSE TO MY VILLAGE.

PREVENTION:

I CAN ENCOURAGE HUNTERS TO NOT USE FIRE TO HUNT AND REMIND THEM THAT THEY WILL BE FINED IF THEY ARE CAUGHT STARTING A FIRE.

CAUSE:

THERE WAS A FIRE DOWN THE ROAD AND AN EMBER TRAVELED TO OUR FRONT YARD AND CAUGHT OUR YARD ON FIRE. THE FIRE SPREAD VERY FAST BECAUSE WE HAVE A LOT OF DRY AND OVERGROWN GRASS.

PREVENTION:

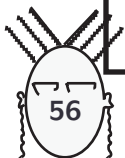
I CAN MAKE SURE MY YARD IS MAINTAINED AND I CAN HELP BUSH CUT AND REMOVE ANY DEAD OR OVERGROWN GRASS.

CAUSE:

WE WERE COOKING IN OUR OUTDOOR KITCHEN AND A SMALL FIRE STARTED. IT QUICKLY SPREAD AND EVENTUALLY CAUGHT OUR HOUSE ON FIRE.

PREVENTION:

MY FAMILY AND I CAN MAKE SURE THAT THERE IS NOTHING AROUND THE OUTDOOR KITCHEN THAT CAN CATCH FIRE. I CAN MAKE SURE THAT I CLEAR OUT ANY DEAD PLANTS OR TRASH.



Lesson 2: Grass-Fire Cycle

Overview

Students will play a game to learn about the grass-fire cycle. They will read over a short handout and create a skit on the grass-fire cycle and how to prevent the cycle from continuing.

Objectives

- Student will understand the grass-fire cycle and how to stop that cycle
- Students will propose long-term solutions to prevent wildfires

Procedures

1. Fire Tag
 - Have students stand in a line shoulder to shoulder. Make sure they are quiet so they can hear all of the directions clearly.
 - Tell students that they are going to play a game that demonstrates the effect of fire on the dry-land forest ecosystem.
 - Ask for two volunteers. Bring them up to the front of the class.
 - Inform the rest of the group that the two volunteers are Fire.
 - Tell the rest of the group that they are all native plants and trees and a part of a fast disappearing endangered dry-land forest.
 - Let them know that they are about to play a special game of tag.
 - Tell them the rules of the game:
 - First set the boundaries
 - This is a game of fast walking (no running) for safety sake. Tell them they can walk as fast as they want, but they need to walk heel to toe (teacher will demonstrate). Tell them that fire commands the center of the playing area. The native plants are not safe in that area. The only place that they are safe is behind the line on the right/left side of the playing area.
 - When an adult says "Go!" all of the trees must fast walk from one side of the area to the other. Fire is allowed to tag as many trees as he/she can. When a tree is tagged it must stop in place, burn to the ground, and then grow back up as an invasive grass.
 - The grass stays in place for the remainder of the game, but now because grass can ignite easily it can tag a tree if one comes near it. The grass is allowed to move one step in any direction but one foot must stay where they were tagged.
 - The trees must now fast walk back through the fire/invasive grass zone
 - The game continues until there is either one tree that can't be tagged or all of the trees have become grass.
2. Reflection Questions:
 - What were some things you noticed?
 - What are some ways that you can stop or slow down fire from spreading?
3. Teacher will project the image on the next page and explain that fire tag game that they just played is an example of the "Grass-Fire Cycle". Teacher will explain the 5 steps of the cycle.
4. Teacher will also project the below two slides and ask the students what they notice about each. Teacher will facilitate discussion about how Palau's land cover contributes to the large amount of fires.



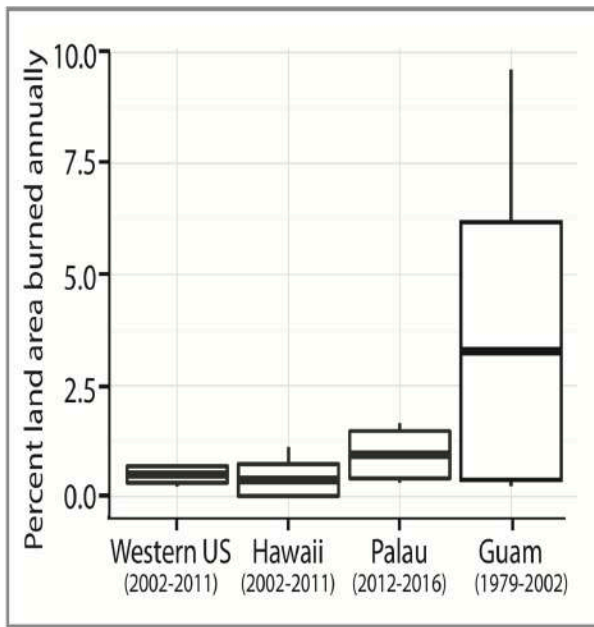


PHOTO SOURCE: PACIFIC FIRE EXCHANGE

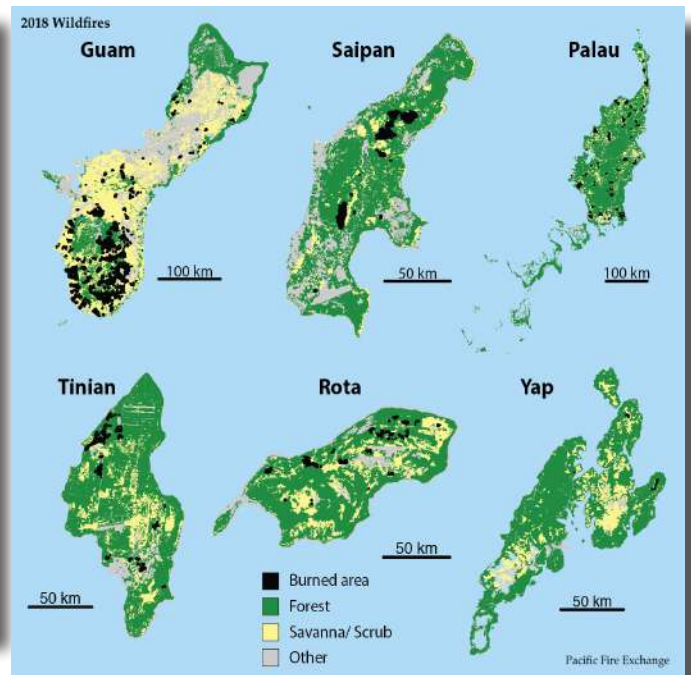


PHOTO SOURCE: PACIFIC FIRE EXCHANGE

5. Teacher will ask students what they think are some long term ways that we can prevent wildfires and also what can limit the success of those strategies. Teacher will provide the following handouts to students: https://www.c4gts.org/wp-content/uploads/2020/05/PFX_FactSheet_GFCycle_Final.pdf Students will read over the handout, and will take notes on the land use management strategies.
6. Teacher will tell the students that they will create a Public Service Announcement (song, skit, video, etc) to explain the fire cycle. They must also include a land use management strategy to stop the grass-fire cycle. Students will use the remainder of the class to work on their PSAs. They will show/performance the PSA next class.
7. Students will take notes on each performance. They will write 1-3 concepts they either learned or were reinforced during the PSAs.

Lesson 3: Firewise

Overview

Students will understand the basic principles of Firewise and will create Firewise checklists that they can use in their homes and communities.

Objective

- Students will understand how to use Firewise principles to reduce the risk and damage of fire to their home

Day 1

Procedure

1. Bell ringer: Teacher will ask students to answer the following prompt: “How safe do you think your house would be if there was a wildfire that was burning close by? What can you do to make your home more fireproof?” Teacher will have students share out answers and record.
2. Teacher will introduce the idea of “Firewise”.

What is Firewise?

Today, as communities grow and more houses are being built, we become part of the ever-increasing landscape where the urban environment meets the wild. Being a resident of the wildland/urban interface has lifestyle benefits, but also risks. Those of us who choose to live in or near a wildland environment have a higher associated risk and personal responsibility for the safety of our families as well as property, pets, and livestock. Our actions can also contribute to the safety of fire and emergency personnel who work to protect our homes. Firewise is a set of principles that involves understanding our wildland environment and taking concrete steps to make our home and surroundings more resilient and survivable ([adapted from: http://www.methowready.org/what-is-firewise-.html](http://www.methowready.org/what-is-firewise-.html))

Teacher will handout the following “Living with Fire: A Guide for the Homeowner”: <https://www.c4gts.org/wp-content/uploads/2020/05/Living-with-Fire-Homeowners-guide.pdf> Teacher will have students split into groups (3-4 per group). Teacher will assign a zone to each group. Each group will be responsible for creating some type of visual representation that will summarize what their zone is and tips to reduce the threat of wildfire in their zone (poster, ppt, song, etc). (Only include items that are found in most houses in Palau). Students will teach the class about their zone. Students will take notes on the presentations for each zone.





FUTURE- MAKERS

Create a checklist for your zone that you presented. Use that checklist to check your house/property. *if you have permission (from both your parent and trusted neighbor, use that checklist for another property in your neighborhood.

*Future- makers note: Tell students they can adjust the checklist when they do their checks, and they will need to bring back the adjusted checklist to the next class.

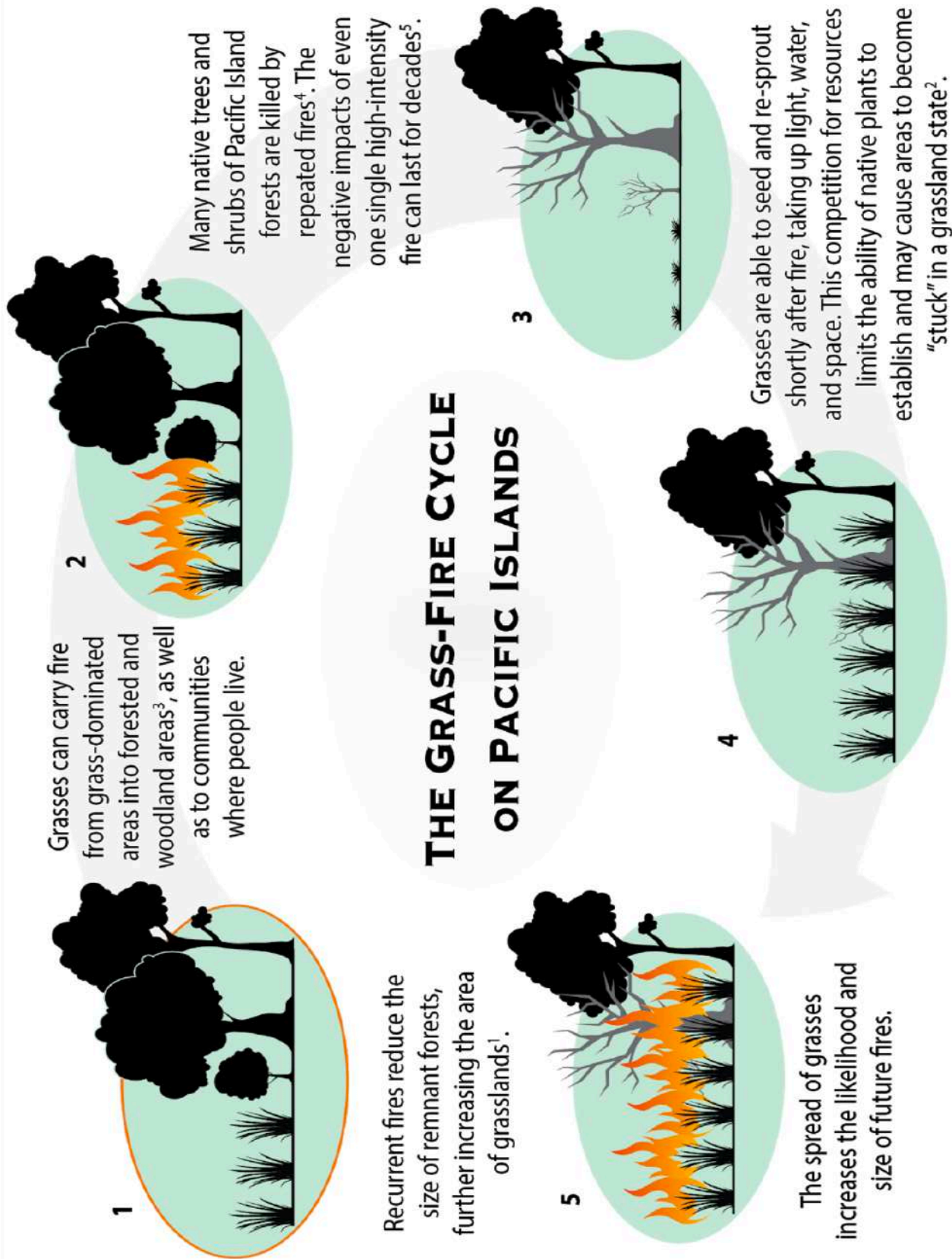
Day 2

1. Bell Ringer: Teacher will have students take out their checklists and answer the following prompt: "How useful were your checklists in checking to see if your house was "firewise"? What can you change on your checklist to make it easier to use?" Teacher will give students a few minutes to make those changes to their checklists. Teacher will have students meet back in the groups they were with during the last class and share the changes they made and come up with a revised checklist.
2. The teacher will then have students create a comprehensive class Firewise checklist. Teacher will put up 4 large pieces of paper on the board (with the 4 zones written on the top: Access Zone, Defensible Space Zone, Interior Zone, Built Zone). Each group will send 1 person up from their group to write 5 items from their checklist. If items are repeated, they can put a checkmark next to the item. Teacher will go over the checklist with the class and have groups explain items if there is any confusion. Teacher will have students copy the list down.
3. Teacher will give the students 15 minutes to work in groups to complete the Firewise assessment for their school building. Students will put N/A where the items don't apply for the school. After they have completed the assessment, the teacher will have students provide feedback on the checklist and ask again what changes can be made.



FUTURE- MAKERS

What are two ways that you are going to contribute to preventing wildfires long term?



PSA Rubric

	4	3	2	1
FIRE-CYCLE	CLEARLY DEMONSTRATES THE CYCLICAL NATURE OF THE GRASS-FIRE CYCLE. RELATES THE CYCLE TO THE INCREASE OF GRASSLANDS IN PALAU AND EXPLAINS HOW THE CONDITIONS BUILD UPON THEMSELVES. PRESENTED IN A CREATIVE AND INTERESTING FORMAT.	DEMONSTRATES THE CYCLICAL NATURE OF THE GRASS-FIRE CYCLE. RELATES THE CYCLE TO THE INCREASE OF GRASSLANDS IN PALAU.	DEMONSTRATES THE CYCLICAL NATURE OF THE GRASS-FIRE CYCLE	EXPLAIN THE LINE OF EVENTS THAT SPREAD THE FIRE, DOESN'T MAKE IT CLEAR THAT IT HAPPENS IN A CYCLE
MANAGEMENT	MULTIPLE METHODS OF MANAGEMENT WERE PRESENTED. THERE WAS A CLEAR EXPLANATION OF HOW THE MANAGEMENT CAN INTERRUPT THE CYCLE.	1-2 METHODS OF MANAGEMENT WERE PRESENTED AND CONNECTIONS WERE MADE ON HOW THEY WOULD INTERRUPT THE CYCLE.	1 METHOD WAS PRESENTED. THERE WAS NO CLEAR CONNECTION OF HOW IT WOULD INTERRUPT THE CYCLE.	MINIMAL EXPLANATION OF LAND MANAGEMENT STRATEGIES

Lesson 4: Service Learning Project

Overview

Students will create a proposal for a service- learning project that they will complete by the end of the quarter.

Duration: 2-3 Weeks

Objectives

Students will create a service- learning project that is aimed at preventing wildfires in Palau.

Procedures

1. Bell ringer: Why is it important for us to prevent wildfires on Palau? What are some ways that we can do that? Teacher will have students think-pair-share with the class. Teacher will create a list of potential projects on the board as students share out. Teacher will have students write down 1 project of the listed ideas (or their own idea that wasn't listed) that they would like to do.
2. Teacher will explain to students that they will be creating a service- learning project. Teacher will give students the service learning handout and explain the different sections. *See Service- Learning Overview.
3. Teacher will have students read over the overview and give time for any questions.
4. Teacher will then pass out the project planning guide: <https://docs.google.com/document/d/1AWNfhw4eZwLKNzn-bjKOx3rIt75UGdPKBdk2mtlGzcrY/edit>
5. Teacher will have students look over the project guide overview and then have them start on the first section "Project Ideas". Teacher will have students use the guide to help work through the Service- Learning Project.



Service- Learning Project Overview

Student Handout

The final project for the fire prevention unit is a service- learning project. You will form your own groups and propose (and then execute, document, and evaluate) a project related to preventing wildfires on Palau. Some project ideas will be discussed in class or you may come up with your own ideas. In addition, all projects should have an explicit educational component where you specify what knowledge you wish to convey to a particular audience, as well as your “lesson plan” for conveying this information.

You must work in groups; no individual projects allowed for this assignment and group size should be appropriate to the project and approved by the instructor. Each member will evaluate the contribution and efforts of themselves and their team members and this information will help in determining individual grades.

Your Report Should Contain a descriptive project title, a list of group members, and the following sections in this order, each with a clear heading. Do NOT combine sections.

- **Introduction** should help the reader understand what is coming in your report and why it is important. It should introduce the need (related to wildfire prevention) that you feel can be addressed by your project and briefly state the specific goals and objectives of your project. Here you should also give some background to wildfire prevention that demonstrates your understanding of the context in which your project will take place. As part of this background you should find and use references (at least 3) about wildfire prevention and how others have addressed it (e.g., how other areas have prevented wildfires?). Properly cite these references in your introduction (and/or other parts of your report) and include them in a reference section at the end.
- **Smart Goals** identify your objectives for your project as well as provide a timeline to complete each objective
- **Educational Plan** where you identify a list of specific learning goals and your audience (e.g., “community members will understand Firewise concepts” or “participants in outreach programs will understand how to prevent wildfire long term”). In addition to learning goals, you should discuss your plan for engaging your audience and conveying this information (e.g., in signs or short presentations or other learning activities such as engaging games).
- **Action Plan** where you again briefly state your objectives and then provide reasonable detail on how you plan to accomplish them. This section should include several sentences describing what the specific tasks need to be accomplished and who will do them. Here you should also include details about what organization or persons outside of the class you will be working with and your plan for communicating with them (including communications that have already happened). Finally, also include any contingency plans you have in case everything does not go as you originally planned.
- **Reflection:** 1-2 page reflection of the overall project. What went well? What would you change? What did you learn?
- **Presentation:** Students will create some form of media (video, poster, etc) to showcase their project to the class.
- **References** in APA format



Step 1: Project Ideas

You will now take what you have learned about wildfires in Palau and create a service- learning project so that you can spread your knowledge to your peers, school and community.

List all the ideas you have for potential projects:

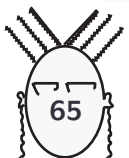
- _____
- _____
- _____
- _____

List all the ideas the class came up with for potential projects:

- _____
- _____
- _____
- _____
- _____
- _____
- _____

Choose your top 3 project ideas and rank them in order of which ones you would like to actually do:

*Find a group of students with similar ideas and form a working group



Step 2: Plan

Smart Goals: Now that you have picked a project idea, you have to decide how to take action! First it is important to pick SMART goals for your project. Setting good SMART goals are the key to successful projects.

The first step in implementing any project is to create “SMART” Project Goals. What are SMART Goals? They are goals that are:

Specific: Goals are clear and unambiguous by answering WHAT is expected, WHY it is important and WHO is involved.

Measurable: Can your goal be measured? Being able to measure your progress and goals will help your team stay on track and focused. Think of answers to the questions: How much? How many? How will I know when it is accomplished?

Achievable: Set your goals high, but attainable. As you grow and develop, your goals become more achievable!

Relevant: Make sure that your goals are relevant to what you are trying to achieve. Ask questions like: Does this match our efforts and needs? Will this help us achieve our desired end result?

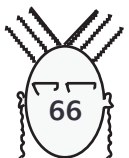
Timely: A time-bound goal (deadline) establishes a sense of urgency and helps your project stay on track and focused.

Work with your group to create 2-3 SMART goals for your Wildfire Prevention project. Example: We plan to raise awareness of climate change solutions by launching a student-run composting program at our school by May.

1.

2.

3.



Education Plan

As a group, you will identify several specific learning goals, who your target audience will be, and how you plan to deliver the intended information. i

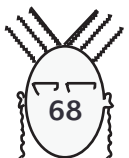
LEARNING GOAL	TARGET AUDIENCE	HOW WILL YOU CONVEY INFORMATION (POSTERS, PPT, ETC)

Action Plan

The action plan will help to ensure that you reach your SMART goals. It will help you identify the steps that you will need to take, as well as identify the necessary resources.

SMART GOAL	STEPS NEEDED TO ACHIEVE GOAL	HOW WILL YOU DO THIS? TASKS?	WHAT RESOURCES DO YOU NEED TO DO THIS?	WHO WILL BE RESPONSIBLE?	HOW WILL YOU KNOW THAT YOU WERE SUCCESSFUL?	DEADLINE

POSSIBLE CHALLENGES	HOW WILL YOU OVERCOME THOSE CHALLENGES?



Step 3: Execute the Plan

Revise and Update

As you carry out your plan, you will likely encounter some unexpected obstacles and complications. It is important to continuously revisit your plan and revise as you work. You may need to adjust deadlines or come up with completely new goals. It will be important that you communicate regularly with your group to ensure that you know what is happening with the project as well as any changes that need to be made.

Step 4: Reflection and Celebration!

Just as it is important to reflect during the project, it is equally as important to take time to reflect on the entire process after your project is complete. The reflection process can help you understand the success and setbacks of your project so that you can be better prepared for your next project.

At the end, you will want to know the impact that your project had and check to see if you accomplished the goals that you set out in the beginning. You should plan to share your reflection with your class so that you can celebrate together. .

Evaluation → Reflect → Learn

Class Presentation:

Students will create some form of visual presentation (ppt, poster, video, etc) that they will present to the class. The presentation should include the following components:

- A description of your service project, including your smart goals
- An overview of your educational plan (learning goals, target audience, tools used)
- What challenges did you face? How did you overcome those challenges?
- What were your major milestones?
- How could you improve this service- learning project if you were to do it again?
- What are 3 things you learned (or ideas that were reinforced) about wildfire prevention from your project?
-

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RIDGE TO REEF

FIRESHED MANAGEMENT

Wildfire Awareness Curriculum, Palau



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