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Wildfire Awareness Curriculum Grades 6- 12

Guam

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**WILDFIRE AWARENESS CURRICULUM
GRADES 6 – 12
GUAM VERSION
APRIL 2020**

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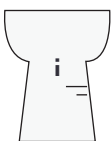
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Contents

Welcome and Introduction.....	iv
Acknowledgments... ..	v
Overview and Objectives.....	vi
Unit 1: Sense of Place	1
Unit 2: The Science of Fire... ..	12
Unit 3: From Ridge to Reef	40
Unit 4: Wildfire Prevention.....	51
Munga Masongge Guåhan Poster.....	70
Munga Masongge Guåhan Coloring Sheet.....	71
Credits	72



Ħafa Adai...

Fire is a human phenomenon on islands

- Clay Trauernicht.

Fire is neither good nor bad. *It is*. 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 we humans, to manage fire well and to prevent its unchecked spread. 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 Guam Forestry, the U.S. Forest Service, the University of Hawaii at Manoa, Center for Getting Things Started, Guam- based educators, and CHamoru cultural experts came together to develop a place-based grade 6-12 wildfire awareness curriculum.

Over the course of a week in June 2019, the team experienced all aspects of wildfire including cultural elements, management, and prevention. We had fun living and working together in Agat, a beautiful southern part of Guam. We even had the opportunity to be part of an actual wildland fire in Merizo, immediately applying what we knew about the fire triangle. The result of these lived experiences, in combination with the wealth of knowledge the team brought with them, is contained in this curriculum in which we explore four themes, or Big Ideas:

- **Sense of Place, Sense of the Issue** - place shapes how we view and use fires;
- **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. While the lens of the curriculum is hot and fiery, the outcome is that we are **FUTURE- MAKERS**, able to eco-systemically mitigate climate change and to adapt quickly and wisely for a regenerative culture.

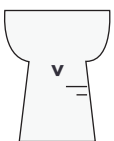
Si Yu'os Ma'āse,

The Wildfire Awareness Curriculum Team

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Design, development and production of Wildfire Awareness Curriculum, Grades 6 – 12 involved the work and contributions of the listed authors, contributors, and partners, and also staff from the USDA Forest Service, the Hawaii Wildfire Management Organization, and Pacific Wildfire Exchange. The hope and intention from the first conceptual meetings about this work with Susan Cordell, PhD, Director and Research Ecologist, and Christian Giardina, PhD, Research Ecologist, USDA Forest Service, Institute of Pacific Island Forestry, have come to fruition due to organizational support and funding. Sincerest Si Yu'os Ma'āse– Thank you – to all who worked on ensuring a relevant and rigorous curriculum. I want to specially thank Carly Wyman, Center for Getting Things Started graphic designer, who also doubled as a copy editor, putting in an enormous amount of time and energy in this beautiful work. Gratitude and appreciation also goes to the Melissa Kunz who contributed to the team's understanding about the importance of data collection and interpretation around wildfires. Finally, I thank all the Wildland Firefighters in the Pacific Region, who risk their lives to save the ecosystems that human-caused fires could easily destroy.

Koh Ming Wei, PhD.



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 Guahan, the Marianas, Micronesia and the Oceania Region • Retell the CHamoru creation story • 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 Guam/Mariana islands • 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. GDOE History and Social Studies: <ul style="list-style-type: none"> • <u>Standard 3: Geography 6.3.1</u> Describe how the physical and cultural landscapes of the world influence the interpretation of the past. • <u>Standard 1: Culture 7.1.1</u> Explain the significance of individuals or groups from selected societies, past and present. • <u>Standard 3: Geography 7.3.1</u> Interpret maps, globes, satellites, images, photographs, or diagrams using the following: <ol style="list-style-type: none"> 1. Geographical information about the world's countries, cities, and environments 2. The concepts of location, scale, map projection, or orientation
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 un-controlled 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>ETSI-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>ETSI-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 Guam • List the different agencies that help manage Guam's natural resources • Explain the roles of three agencies with respect to managing 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: <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.
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 Guam'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 goal of Unit 1 is to understand cultural values and connect students to the natural resources of the Mariana Islands, thus establishing a strong sense of place, to create awareness about 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 Guahan, the Marianas, Micronesia and the Oceania Region • Retell the CHamoru creation story • 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 	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	<ul style="list-style-type: none"> • Name and identify the different habitats of Guam/Mariana Islands • 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 	GDOE: <ul style="list-style-type: none"> • <u>Standard 3: Geography 6.3.1</u> Describe how the physical and cultural landscapes of the world influence the interpretation of the past. • <u>Standard 1: Culture 7.1.1</u> Explain the significance of individuals or groups from selected societies, past and present. • <u>Standard 3: Geography 7.3.1</u> Interpret maps, globes, satellites, images, photographs, or diagrams using the following: <ul style="list-style-type: none"> • Geographical information about the world's countries, cities, and environments • The concepts of location, scale, map projection, or orientation

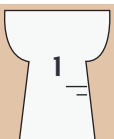
Introduction

Teacher will read or assign this introduction to students to read and share:

The islands of the Marianas are the homeland to the CHamoru people. Today, Guåhan and the fourteen islands of the Northern Marianas are home to many people from the rest of our island region (Micronesia) and many other parts of the world. It is the responsibility of all who call the Marianas home to learn about the islands environment and the history. We all have to contribute in caring for our island environment so we can be Future- Makers and not Future- Takers.

Class Discussion- compare and contrast what makes someone a FUTURE- MAKER versus a FUTURE- TAKER?

The difference between being a Future Maker and a Future Taker is your behavior. Respect or *Respetu* is a central



CHamoru value. You must have respect for yourself, for others, for our islands, ocean and planet. The health of the environment is interconnected to many other issues. 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 CHamoru 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 of 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. The second half of Lesson 1 establishes a sense of the issue of wildfire for the Mariana Islands.

LESSON 1: SENSE OF PLACE

Remembering Our Ancestors, Acting For Our Descendants

Tinituhon- The Beginning

According to the CHamoru creation myth, people first came to be with brother and sister, thus establishing the family as the center of the CHamoru experience. Fo'na the creation goddess created the universe and life, she is the first woman. CHamoru were a matrilineal society, meaning land was passed down through the mother's clans. The balance and equality between the men and women, young and old is something we must still strive for.

People have different ideas of the way the world was created, and how and when life and humanity began.

Fo'na Yan Pontan, Mariana's Creation Story: <https://www.youtube.com/watch?v=dnpLZrdCW9U>

CHamoru Values

Values are the things that you believe are important in the way you live and work. They (should) determine your priorities, and, deep down, they're probably the measures you use to tell if your life is turning out the way you want it to. As islanders, we live in small places and our ancestors had to make sure our resources were clean, safe and protected, especially for future generations. Our families, our villages and our whole community are very close-knit and intertwined. Early CHamorus lived off the land. They understood the value of taking only what you need and leaving enough for tomorrow and the future.

- Inafa'maolek- Harmony, to make good for everyone. Cultural Values/connections between islands and culture. People of the LAND and SEA- Interconnectedness. We are ONE- Taotao tano, Taotao tasi
- Uno Hit- We are One. Realizing that we are one with the environment, with each other and with the past and the future. Having this realization that all life is interconnected is powerful in changing our behaviors for the better of all.
 - Recording of "Uno Hit" Melody: <https://youtu.be/OXfnYwLSeRk>

Activity:

Bring students outside and gather in a circle, having them repeat the chorus of the song "Uno Hit" in a call and response style, line by line.

uno hit yan i tano
uno hit yan i tasi
uno hit yan i atdao
uno hit yan i langet.

We are one with the land.
 We are one with the sea.
 We are one with the sun
 We are one with the sky.
 uno hit. We are one

- Respetu- Respect

Optional Activity- Draw side by side comparisons of what it looks like when people "Have Respect", (Gai Respetu) versus when people "Do not Respect" (Tai Respetu) an island and its resources . (Teacher will have students in groups or individually draw a poster to interpret the respectful and disrespectful interactions of people with the islands.) Another alternative shorter activity is brainstorming a compare and contrast list, solicited via popcorn style or in small groups.

- Māta- Eyes/Insight or Awareness. At a very young age, families usually teach us to be very respectful when going into the jungle (halom tano) or the ocean. Children are taught to ask the ancestors (taotaomo'na) for permission before entering or relieving themselves in those spaces. This cultural protocol or the acknowledgement of the presence of the ancestors is a part of our indigenous insight or our māta. Below is an example of a song written about this.

- Permission Chant- Introduction to "Ginen Hāgu" or "From You" Inetnon Gef Pā'gu: https://youtu.be/EfdF_obr4Hc (first 2 minutes)

"Guella yan Quello, ko sina maloffan guini gi tano'- mu. Guella yan guella ko sina maloffan guni gi tano'-mu. Guella yan guellp, ko sina malaffan gi tano'- mu, I manchamoru."

-Ancestors, may I please pass here, through your land (3x). The land of the CHamoru people.

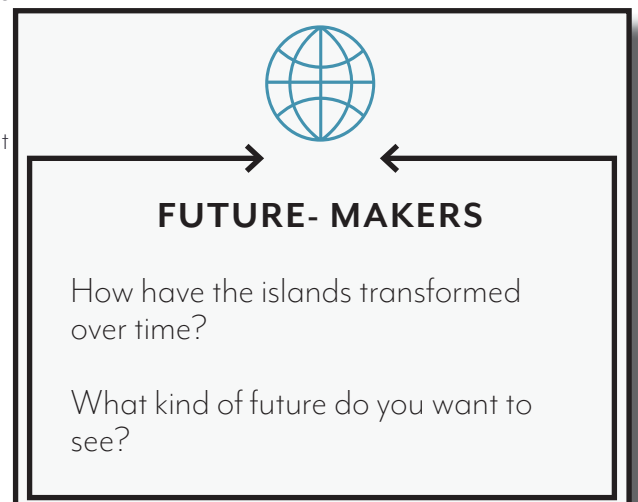
The Island Environment

We exist in a sea of islands. Our ocean is a great connector. We have always relied on the ocean for food and to connect us to others. We are interdependent. It is important that we get to know our islands environment- the geography, the habitats, our special plant and animal species and the ways that human behavior threatens the balance of the ecosystem. There is a lot of basic information in this section that will help us to understand where we are, what we have on our islands and the best ways to protect it all for the present and the future.

Geography

Maps - Use the assistance of technology, i.e. search engines, to help correctly fill out and label the maps below. Don't forget to indicate the cardinal directions.

- Oceania
- Micronesia
- Marianas
- Individual islands (Guam and Saipan)



Different Habitats of Guam/Marianas

Using this prezli link have students learn and explore the varying habitats on our islands. Break the into 5 groups to create a poster board of the 5 different habitats.

<https://prezi.com/wq2ubianinpi/copy-of-adventure-island>

- Limestone forests
- Savanna-grassfire cyle
- Beach Strand
- Marsh/Wetlands Mangroves
- Ravines

Activity

Watch the following video: <https://youtu.be/5rss9SktWjg>, What kind of ancestor will you be? A film by nihikids.

VOCABULARY

Native Species:
Plants and animals that originated and live in an area without any human intervention

Endemic Species:
Plants and animals that exist only in one geographical region.

Introduced Species: an organism that is not native to the place or area where it is considered introduced and instead has been accidentally or deliberately transported to the new location by human activity.

Invasive Species:
A species that is: 1) non-native (or alien) to the ecosystem under consideration and. 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

Lesson 11: Sense of the Issue

Drawing Activity

Examine the role of fire in our lives. Have students reflect on and draw the nways fire has been used and what fire means to them in their personal lives.

Cultural Significance

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, why? Use maps to discuss which areas of the islands of Guam and Saipan are vulnerable to wildfire.

CHAMORU WORDS ASSOCIATED WITH FIRE

åsu- smoke

åpu- grey/ash

ånglo- dry (ir-dry)

chåhan- ancient earthen or underground cooking technique using heated river stones, banana leaves and taro leaves

fotgon- moist

riffa- CHamoru

spiritual reading ritual using fire, coconut oil and sacred leaves

såffe- CHamoru energy cleansing ritual often using dried sacred herbs to create smoke while reciting incantations and prayer

songge- burn

tunu- barbeque

maipe- hot in temperature

Activity- DIY Map Puzzle



Materials:

1. Printed blank black and white maps
2. Thin cardboard (i.e. cereal boxes and snack boxes)
3. Glue
4. Scissors or Exacto knife

Instructions:

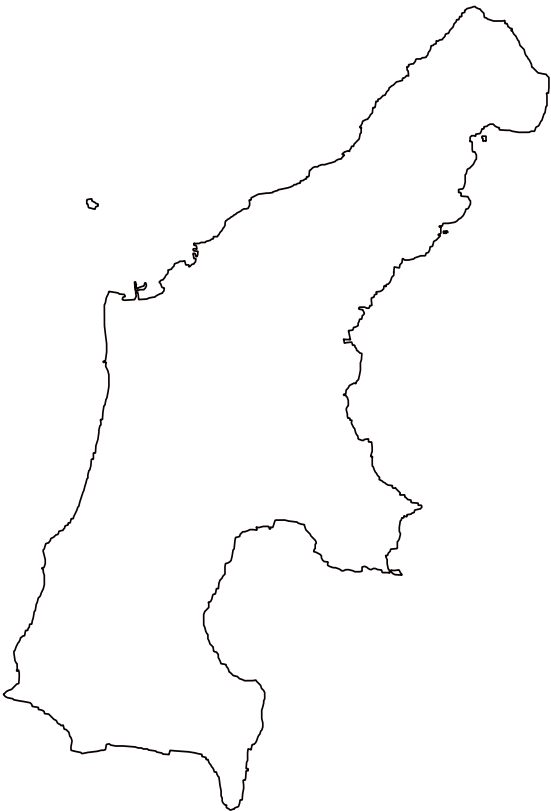
1. Divide students into groups of 4. Each student group will make their own puzzle map. (Oceania, Micronesia, Marianas, Guam).
2. They are to color, label and include a map legend.
3. Glue the maps on the cardboard and let dry.
4. Cut the maps up into 5-10 pieces.
5. Have students exchange puzzles to learn the geography of the entire region.

ACTIVITY SOURCE: HOMESCHOOL MOTHER TASI BENAVENTE

Guam



Saipan



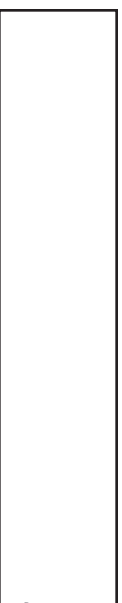
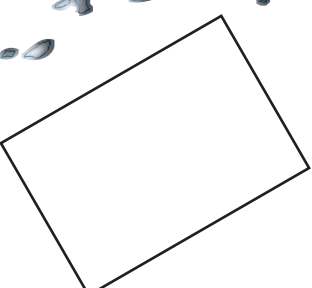
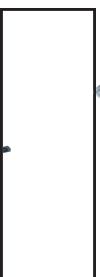
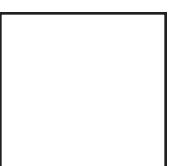


**Southern
Guam**

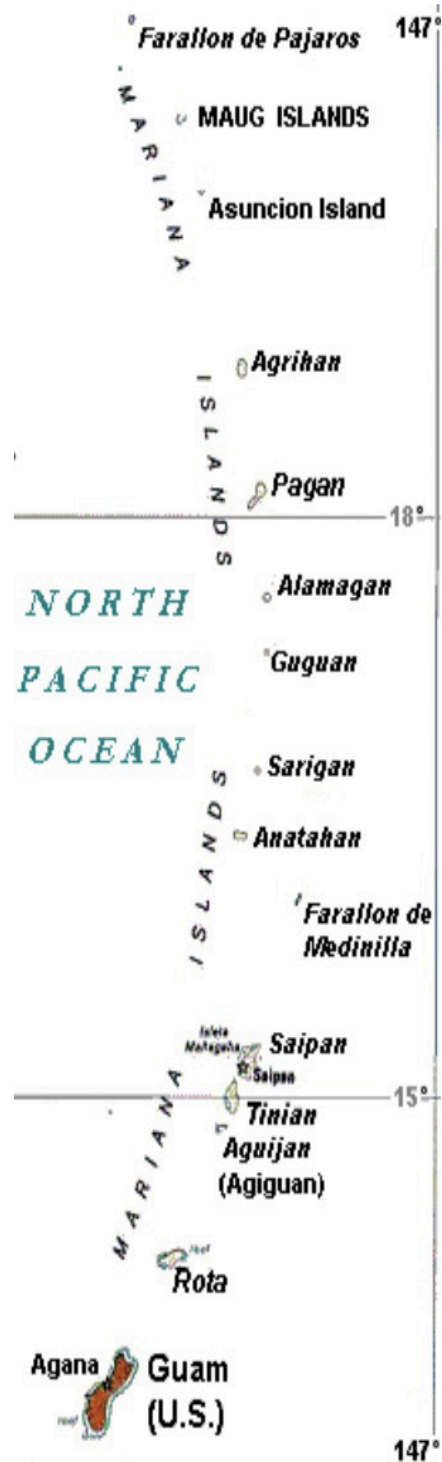


Saipan

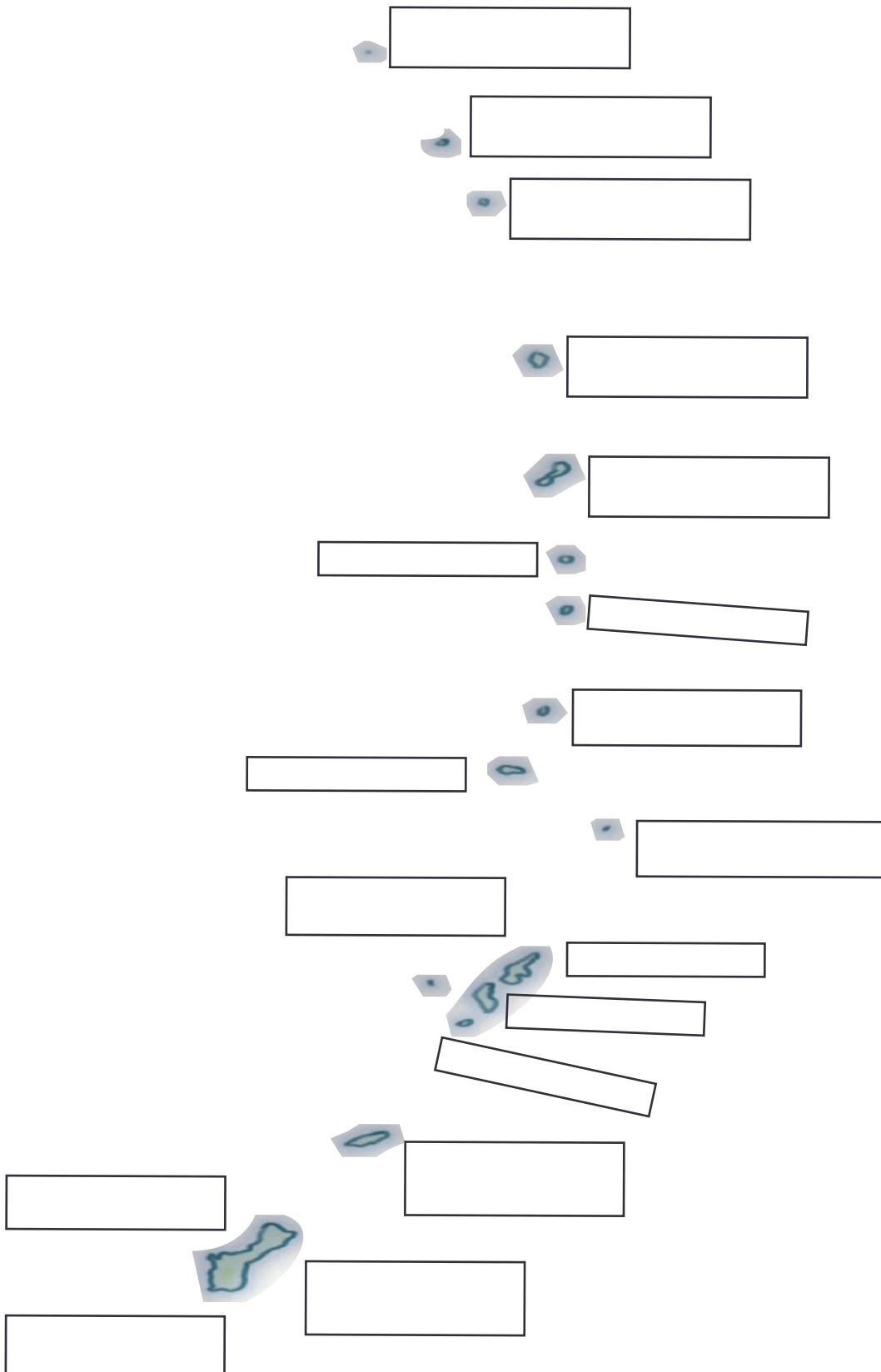
Micronesia Region



Mariana Islands



Mariana Islands



**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 when camping or barbecuing, the consequences of uncontrolled fires, and be able to discuss the risks of playing with fire. 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: <ul style="list-style-type: none"> Knowledge <ul style="list-style-type: none"> Understand how easily a wildfire can start and get out of control. Know about safe fire practices when camping. 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 fire that burns in a natural area such as a forest, grassland, or prairie (source: www.ready.gov/wildfires).*

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 mountains.

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

These are the main causes of wildfires across the islands. Human ignitions are the cause of ALL OF GUAM'S wildfires. Causes are listed in order of significance:

- **Arson:** Intentionally- set fires with the intent to destroy and burn resources. When fires are set on purpose, this is called *malicious intent*.
- **Backyard burning of debris:** Permitted and unpermitted burning of debris if badly managed, or if weather conditions change suddenly, can cause wildfire.
- **Escaped agricultural fires**
- **Smoking:** Discarded cigarette butts can cause wildfires, improperly thrown out by passing pedestrians or motorists.
- **Cooking fires:** Open fires for cooking and discarded hot ashes can cause wildfires.
- **Prescribed burns:** These are conducted by Guam forestry under very controlled conditions to promote growth and prevent uncontrolled wildfires. These are done to support a resource concern and/or farmers when weather conditions are right. This requires a permit and coordination, otherwise citations can be issued.

NWS Guam Fire Watches/Warnings

Red Flag Weather Conditions: A combination of ongoing dry weather (often drought-related), with stronger winds, and low humidities, that, when coupled with dry fuels (browning shrubbery, swordgrass, dead trees), could lead to dangerous, fast-spreading wildfires that are difficult to contain and require additional personnel and resources to bring wildfires under control. Wind shifts can make fire fighting more difficult and increase the erratic behavior of wildfires.

Guam Red Flag Criteria:

- 1: 10hr fuel moisture <13. (Often during dry season and monthly precipitation is <2" and dew no longer forms in the morning;
- 2: Winds of 20 mph or higher for more than 1hr;
- 3: Minimum RH <60% for more than an hour;
- 4: KBDI value >600 (High or Extreme Category)

Fire Weather Watch

- ◆ Issued when there is a high potential for the development of Red Flag conditions.
- ◆ Often issued 12 to 48 hours before conditions are met.

Red Flag Warning

- ◆ Issued when Red Flag Conditions ARE OCCURRING or IMMINENT.
- ◆ Usually not issued more than 12hrs early.
- ◆ Will remain in effect ONLY when conditions are being met

An RFW does not mean fires WILL occur, just that those that exist will be difficult to control.

Things you can do to reduce the risk of wildfires

- ◆ Check with your local fire department for burn conditions before starting a fire.
- ◆ When burning outdoors, ensure you have a reliable water supply and hoses to douse flames and to keep the fire from spreading. Hoses should be long enough to reach any area of your home and other structures on your property.
- ◆ Create a buffer around your house by maintaining vegetation to slow or stop the spread of wildfire.
- ◆ Keep your yard and shrubbery trimmed. Remove all dead and drying vegetation and combustible materials that are within 50 feet of your home.
- ◆ Trim trees to keep branches a minimum of 10 feet from structures.
- ◆ Report low-hanging power lines to proper authorities.

Guam Fire Weather Forecast

- ◆ Issued daily from 1 November - 31 May (or later into June or July until wet season rains return)
- ◆ Discusses the weather pattern and outlook of fire weather watches or warnings
- ◆ Includes a tabular forecast of various weather forecast parameters
- ◆ Can be found on our website under "Fire Weather"

Contact Us

NATIONAL WEATHER SERVICE
FORECAST OFFICE GUAM
3232 HUENEME ROAD
BARRIGADA, GUAM 96913

National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Website: weather.gov/gum

Phone number: (671) 472-0900

Facebook: <https://www.facebook.com/NWSGuam/>

Last Updated: January 2020

WILDFIRES ON GUAM

A Guide to Understanding Guam's Fire Danger



"The tropics get a lot of rain...how can it ever be dry enough to burn?"

Guam's Seasons: **DRY** and **WET**

Dry season:

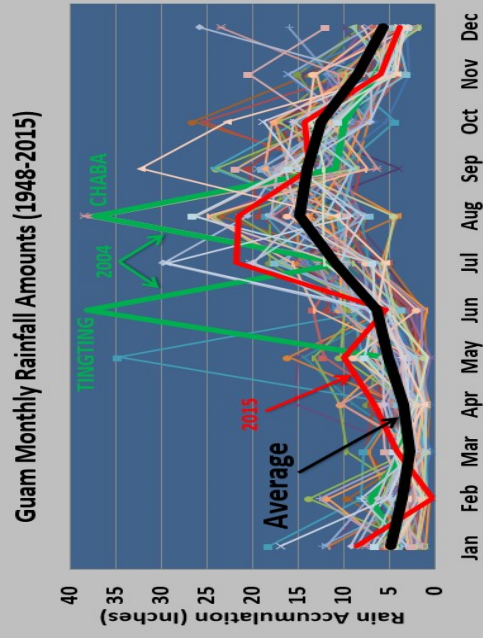
- ♦ Usually lasts from January - May*
- ♦ Averages ~6" of rain per month
- ♦ March often sees the lowest amount of rain
- ♦ **Trade winds** are stronger
- ♦ Showers are short-lived, low-intensity, and rapidly move off-island due to stronger trade winds. Thus, little accumulation of rainfall.

(Less than 4" in a month generally constitutes a drought on Guam)

Wet season:

- ♦ Usually lasts from July - November*
- ♦ Averages ~14-15" of rain per month
- ♦ August/September often see the largest amount of rain
- ♦ Winds are weaker, showers have more vertical development (taller clouds). This results in more intense showers that last longer, thus, a much greater accumulation of rainfall.

(Tropical cyclones greatly increase monthly rain—often measured in feet!!)



*June and December are usually transition months between the two seasons, but depending on the El Nino / La Nina cycle, either month could be much wetter or drier.

The El Nino / La Nina Cycle

- ♦ El Nino increases monsoon activity in the western Pacific, which leads to greatly increased rainfall and a 3x higher chance of tropical cyclones affecting Guam
 - ♦ Enhanced rainfall leads to quicker-growing and thicker vegetation around the island
 - ♦ Typhoons affecting Guam increase the amount of dead foliage and debris
 - ♦ **Dry season** AFTER an El Nino is much drier and lasts longer, often lingering into July or August
 - ♦ La Nina following an El Nino brings stronger **trade winds** and fewer clouds and showers to the island
 - ♦ Vegetation quickly dries and browns—especially in the central and southern mountains.
- (Lack of morning dew and cracking soil (dirt and clay) usually indicate a drought in progress)



Trade Winds, Increase Fire Spread

- ♦ Trade winds are strongest in the dry season
- ♦ They quicken the drying of wildland fuels (low brush, swordgrass)
- ♦ They increase fire spread by sending heat up slopes (even faster drying) and carrying burning embers to new, unburned fuels—creating spot fires
- ♦ Aid combustion by increasing the supply of oxygen

Guam's Fire Danger Rating

The National Weather Service office of Guam uses the **Keetch-Byrum Drought Index (KBDI)** and forecast winds to assess the daily fire danger rating. The drought index assesses the amount of moisture in the soil by considering the daily maximum temperature and the 24hr rainfall for that day. The KBDI is calculated once a day.

The KBDI ranges from 0 (meaning fully saturated ground) to 800 (extreme drought conditions).

The KBDI value indicates how many **hundredths of an inch** of rain is needed to saturate the soil, i.e. a **HIGH** KBDI of 542 means 5.42" of rain would be needed to saturate the ground.

KBDI values are divided into 5 categories:

LOW 0-299 KBDI	MODERATE 300-499 KBDI	HIGH 500-699 KBDI <i>Low Wind</i>	VERY HIGH 600-699 KBDI <i>Strong Wind</i>	EXTREME 700-800 KBDI <i>Any Wind</i>
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LOW: Fires are hard to start and will be slow to spread.

MODERATE: Some brushfires are possible; use caution if burning.

HIGH: Wildfires are possible. Fires can spread rapidly and could become difficult to control if windy.

VERY HIGH: Fires will start easily, spread rapidly, and intensify quickly.

EXTREME: Fires can spread furiously. Every fire has the potential to become large.

Once the KBDI enters the **HIGH** category, outdoor burning is not recommended. However, even when the fire danger is in a lower category and outdoor burning is permitted, steps should still be taken to reduce the chance of the fire spreading to other flammable objects or, on windy days, burning embers floating downwind and possibly starting additional fires.

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 starve 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 1. 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.



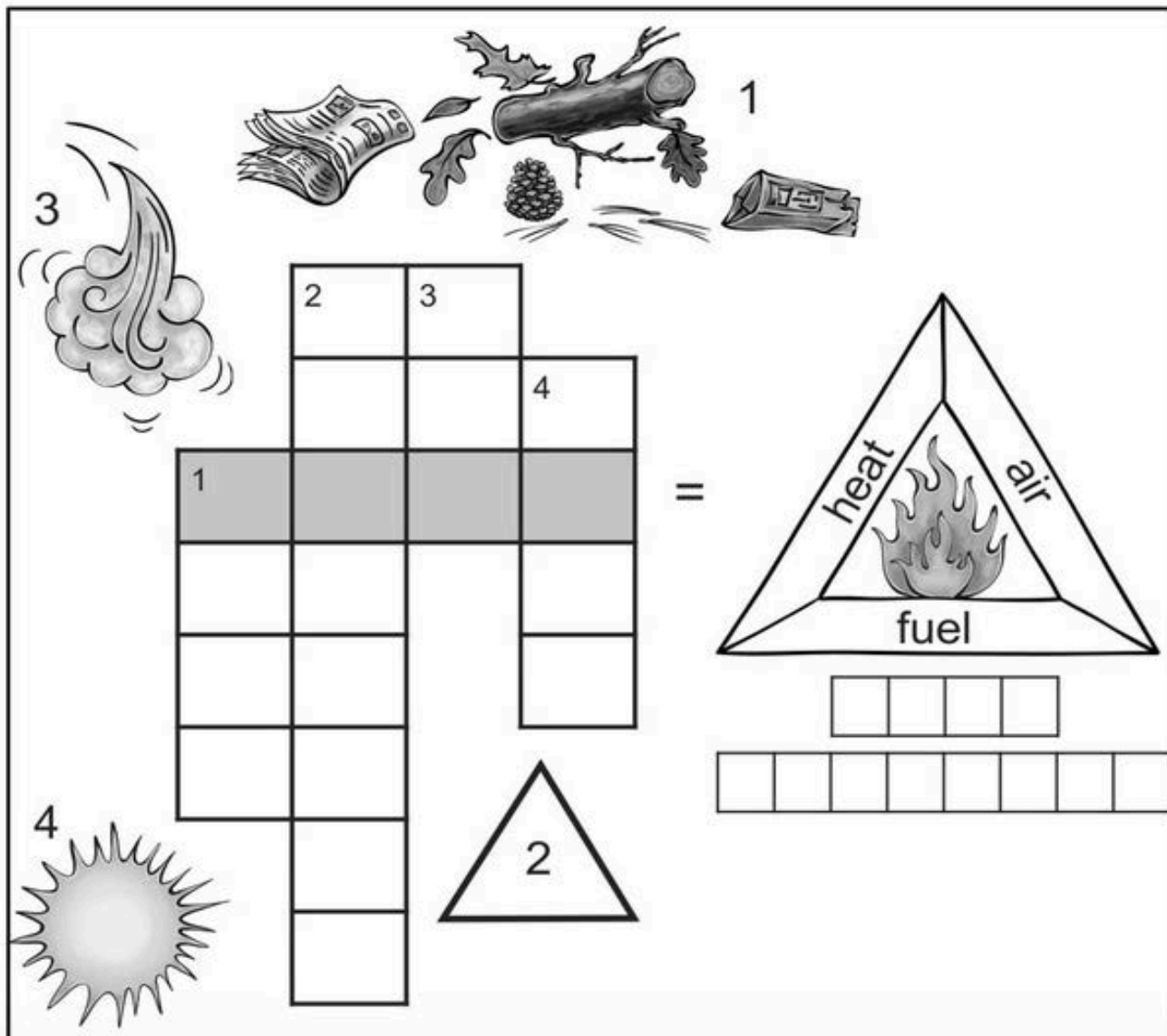
What Fire Needs to Survive Student Worksheet



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

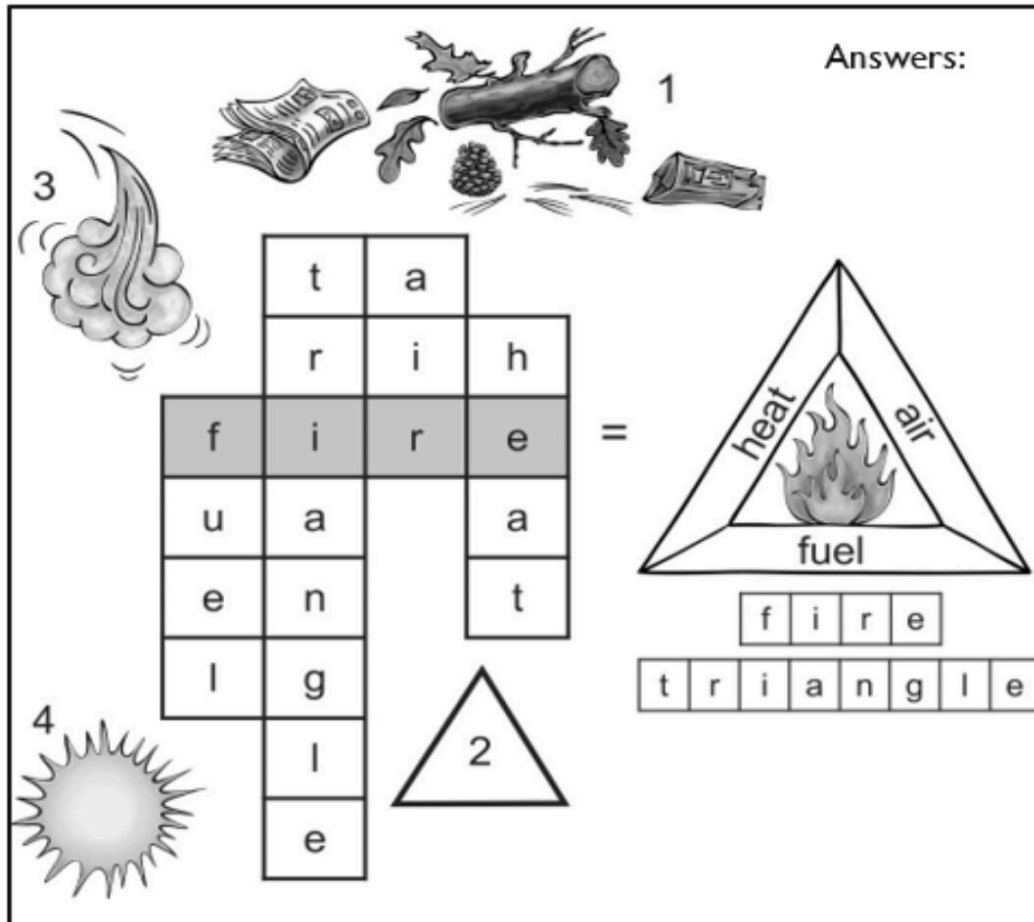
The Fire Triangle Puzzle Activity:

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.

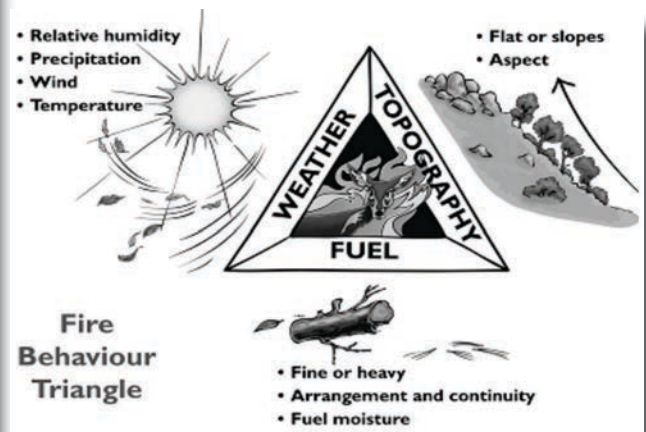
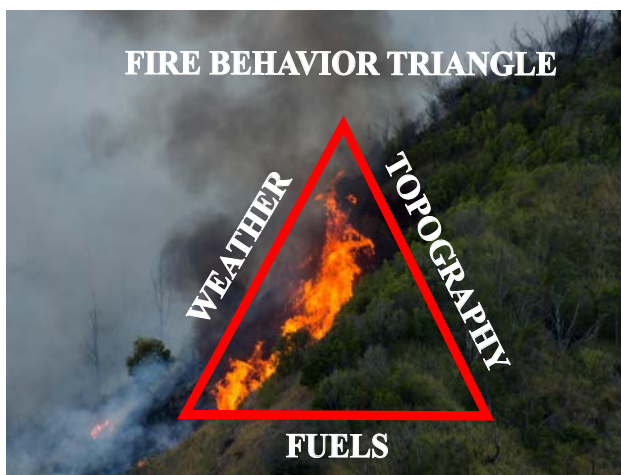
BACKGROUND INFORMATION

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

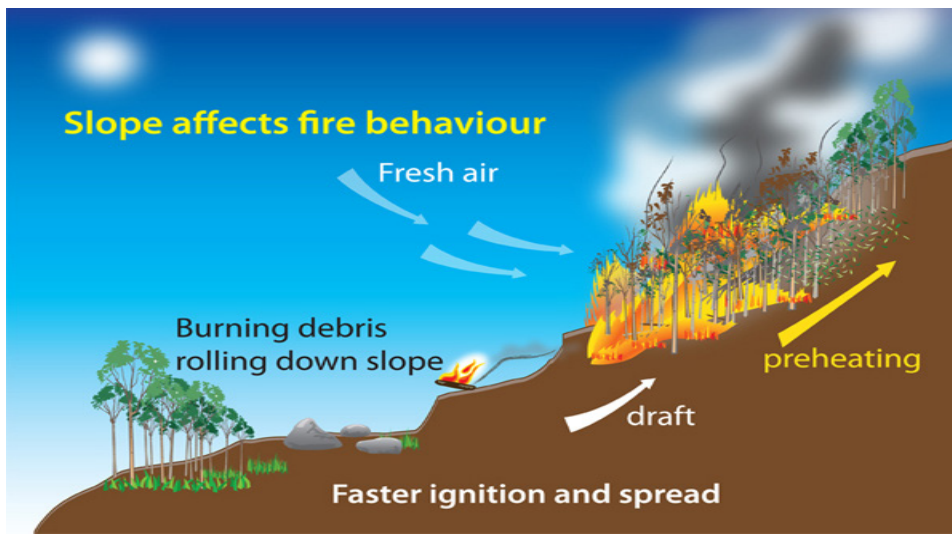
Topography describes the lay of the land and affects the direction in which and speed at which a fire will travel.

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.



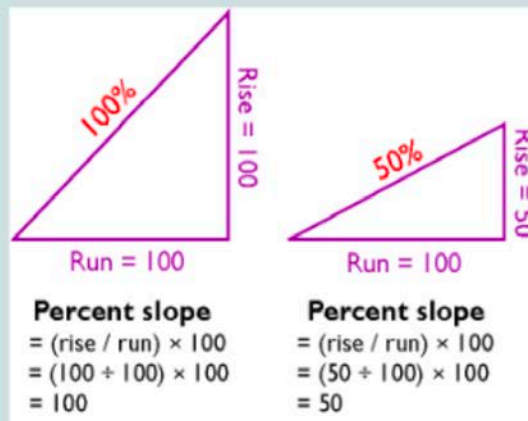
What is Slope (for the ground)?

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.

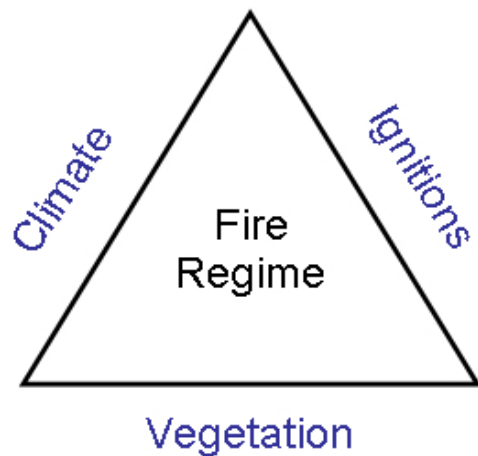


Photo Source: https://www.researchgate.net/figure/Controls-on-a-fire-regime-The-vegetation-axis-incorporates-fire-related-characteristics_fig4_228900673

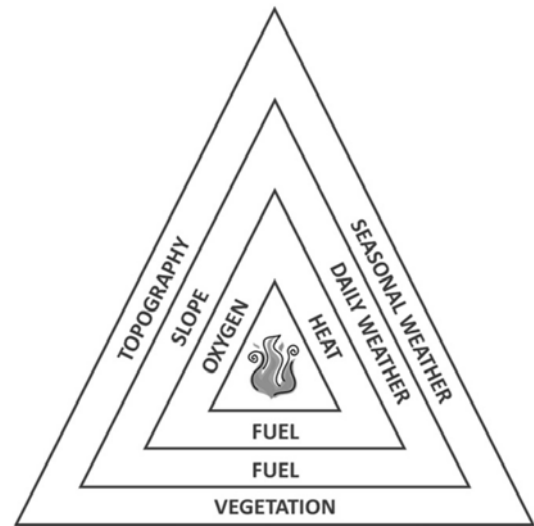


Diagram source: Keane, R.E. 2015. Wildland fuel fundamentals and applications. New York, NY: Springer.

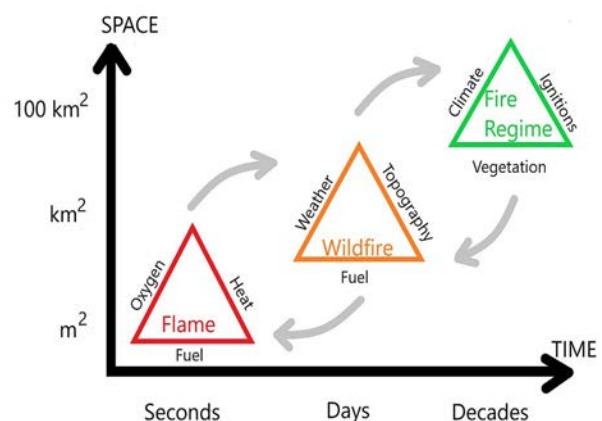


Photo source: https://www.wikiwand.com/en/Fire_triangle

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.

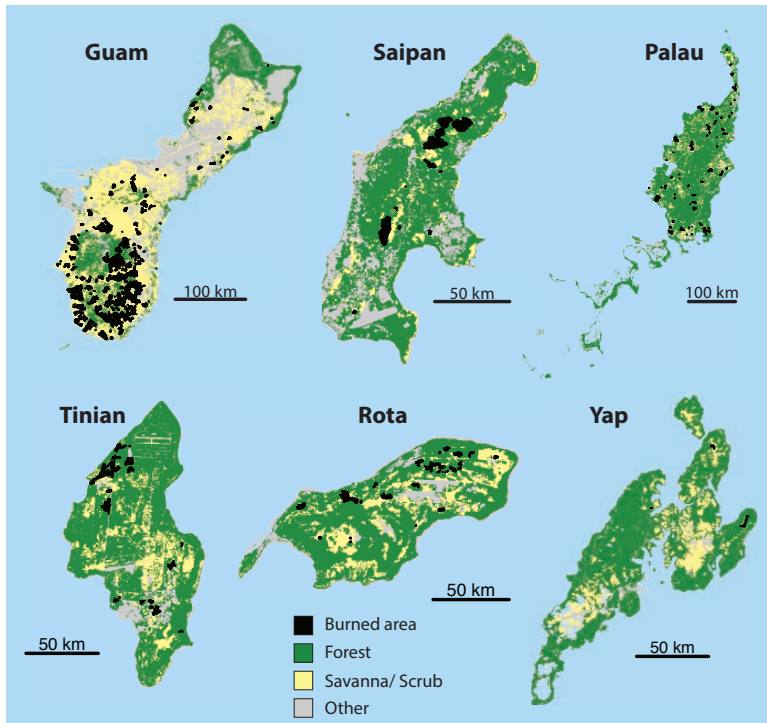


Figure 1. Island land cover, with areas burned by fires in 2018 indicated in black. Land cover data from LANDFIRE.

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 Guam in 2018? _____
2. What is Guam'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 land did Guam's wildfire burned? _____
6. Was that more or less than the number of fires that occurred?
7. Although Guam experienced more rainfall in 2017-2018 than average, what increased?
A) Oxygen load
B) Fuel Load
C) Heat Source
8. What management activities in 2018 were implemented to address fire risk in Guam?
9. Why do you think Public outreach and awareness programs for the Pacific were considered one of the Management activities?
10. How will you involve yourself and your class in being part of this Fire risk management activity?

LAB ACTIVITY 4: MANAGEMENT ACTIVITIES

This is a possible field trip idea you can incorporate and network with Guam Forestry to help mitigate Wildfires on Guam

<p>1.) REMOVING DEAD TREES AND LADDER FUELS TO REDUCE RE DAMAGE TO FORESTS AND CREATE SAFER CONDITIONS FOR FIREFIGHTERS.</p>	 A group of people are working in a wooded area. One person in a blue shirt is carrying a large green bag filled with dead branches and leaves. Another person in a white shirt is standing nearby. A black pickup truck is parked in the background.
<p>2.) 'GREENBELT' REFORESTATION AND FUEL BREAKS</p>	 A person wearing a blue long-sleeved shirt, black pants, and a wide-brimmed hat is using a long-handled tool to clear vegetation in a field. Other people are visible in the background.
<p>3.) CREATE FIRE BREAKS AROUND RESIDENCES VULNERABLE TO WILDFIRE.</p>	 A group of people are working together to clear a path through tall grass and brush. One person is using a tool to cut the vegetation. The background shows a hilly landscape.
<p>4.) LIMITED ACCESS TO THE MOST RE-PRONE AREAS, RESULTING IN A DECREASE OF BOTH IGNITIONS AND AREA BURNED.</p>	 A black rectangular sign with white text that reads "TRAIL CLOSED DO NOT ENTER". The sign is placed in front of a blurred background of green foliage and a dirt path.
<p>5.) WILDFIRE AWARENESS IN PUBLIC EDUCATION AND OUTREACH, INCLUDING SCHOOL PRESENTATION PROGRAMS WITH FORESTRY DIVISION,</p>	 A group of people are sitting around a white table in a room with large windows. They appear to be engaged in a discussion or presentation. Some people are looking at papers or devices on the table.

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 Guam List the different agencies that help manage Guam's natural resources Explain the roles of three agencies with respect to managing resources Create solutions to help prevent wildfires Differentiate between managed and un-managed fires Identify native plants that will be used in the reforestation project 	NGSS: <u>Engineering Design</u> ETSI-1: 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. ETSI-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
Lesson 02	Wildfires and their impacts		

Essential Questions

- What ecosystems on Guam are affected by wildfires?
- Whose responsibility is it to protect our natural resources?
- How am I affected by wildfires?

Anticipatory Set

Quick write: Student will have a quick write explaining how wildfires affect them. Expect some student to not be able to list down ways that they are affected by wildfires.)

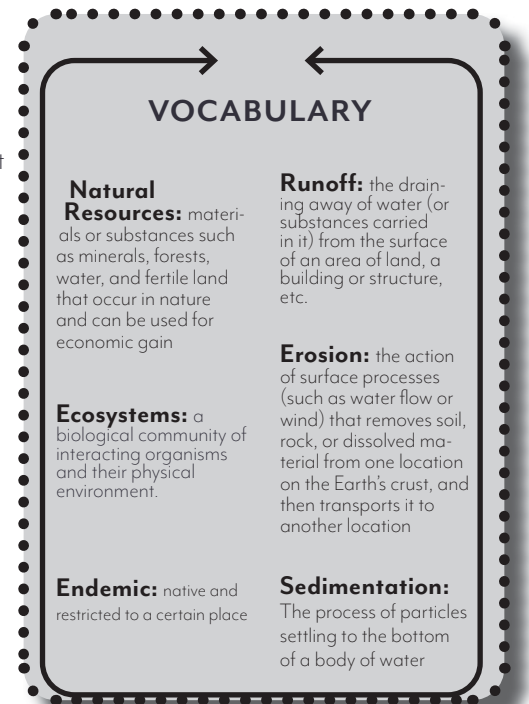
Example list of ways fires affect us.

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

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 natural resources do we depend on in Guam? Teacher lists the answers on the board.



Examples:

- Water
- Trees
- Marine life
- Soil

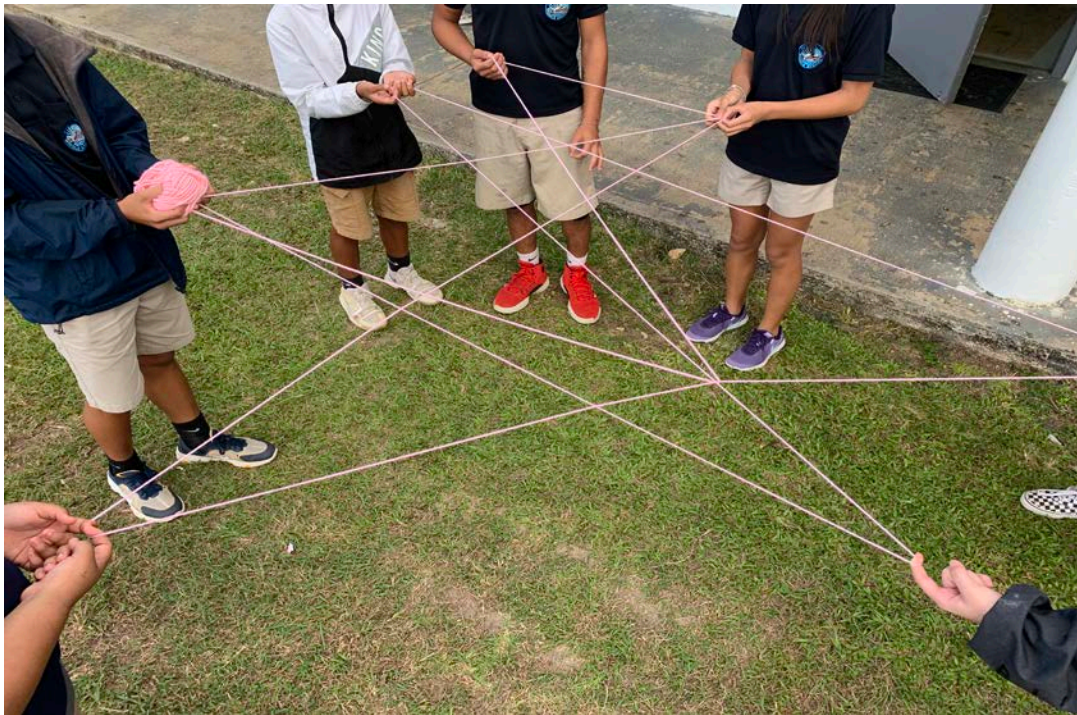
Follow up questions: What natural resources do we depend on in Guam? The answers may be similar to the first list.

Activity: 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



In this activity the teacher will introduce what an ecosystem is. Then the class will discuss different ecosystems they can think of on Guam. The teacher can also take the class around the school or nearby park to see what different species are around and discuss what roles they play in their ecosystem.

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 to 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 show 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 is 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.

Examples of potential food chains:

Mango tree>fruit fly>gecko>chicken

Mariana Eight-Spot butterfly> Micronesia Starling>Brown Tree Snake

Flame Tree>Looper>Skink

Seaweed>Unicorn Fish> Blacktip Reef Shark

Plants

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

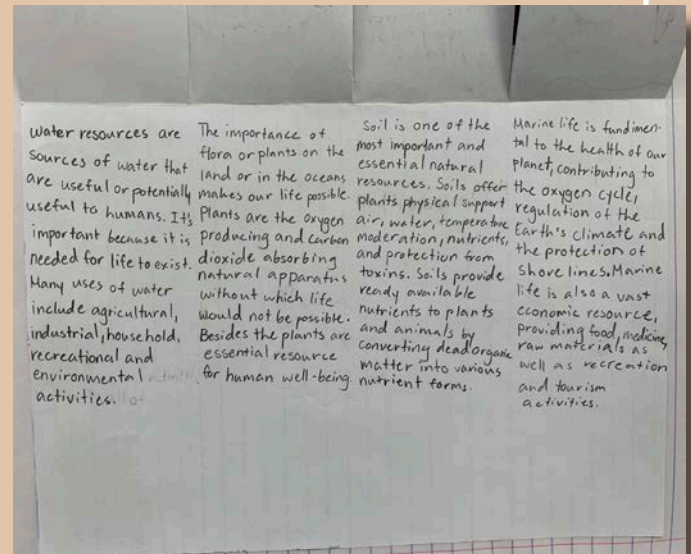
Teacher prepares pictures of wildfires, erosion, sediment smothering the reef, loss of habitat, shift in the system.

Teacher asks: what are disturbances to ecosystems.

List the answers: Wildfire, typhoons, drought, etc

Teacher can show the pictures and students can explain.

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.

5. 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



GUAM 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

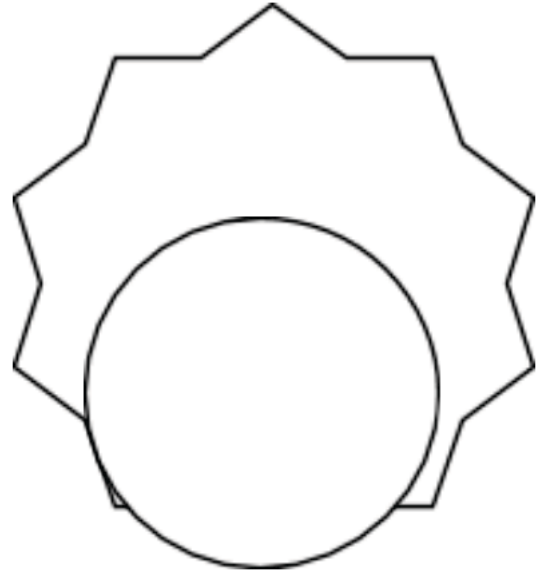


PHOTO SOURCES

GUAM 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

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

Agencies Include:

- Guam Department of Agriculture :
 - Forestry and Soil Resources Division (FSRD)
 - Division of Aquatic and Wildlife Resources (DAWR)
 - Conservation Law Enforcement
 - Biosecurity Division
- Guam Fire Department
- Guam Environmental Protection Agency (GEPA)
- National Oceanic and Atmospheric Administration (NOAA)

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?**

The **Guam Department of Agriculture Forestry and Soil Resources Division** has multiple project sites throughout the southern part of Guam. These sites are reforestation sites on and adjacent to badlands, savannas, and where erosion is a recurring problem. The badlands and savannas are environments that experience repeated burning. Below are some of the different sites that the Guam Department of Agriculture manages.

- Piti-Asan Watershed Management
 - Masso Reservoir and Watershed Mitigation: This project was aimed to enhance water quality entering the Piti Preserve by decreasing the amount of sediment being transported by the Masso River. To reduce the amount of sediment parts of the surrounding savannas were transformed into forest. A green belt was also planted at the site to help protect the project from wildfires. As of February 2016 more than 14,000 plants and be planted on the 29-acre reservoir.
- Manell Watershed Reforestation Project (Merizo)
 - According to GuamServiceLearning.com "The project is spearheaded by the Department of Agriculture, Forestry and Soil Resources Division and supported by partners from the Bureau of Statistics and Plans and NOAA - under Guam's Coral Program and NOAA's Habitat Blueprint initiative. The reforestation work is designed to accomplish a number of goals: reduce erosion and sedimentation to protect reefs and other marine resources; restore tree cover to hillsides to shade out fire-prone grasses and to promote soil health for native tree restoration; restore vegetation other than grass to hold more water on the hillsides and help reduce flooding incidents in the village." The project is funded using USDA Forest Service grant funding and a Landscape Scale Restoration Grant.



- Quinene Road Site: This site covers 17 acres. Since 2015 11,000 trees have been planted by the Department of Agriculture Forestry and Soil Resources Division with the help of students, military members, and members of the public.
- As Gadao Site: This site covers 100 acres. 8,200 trees have been planted by the Department of Agriculture Forestry and Soil Resources Division with the help of students, military members, and members of the community.
- COTAL Conservation Area: This is a conservation area that was established more than 50 years ago, that covers 662 acres. Before reforestation, the land was mostly savannas and badlands. Now the site is an acacia forest. Since the acacia trees help build healthy soils, native plants have been planted to help restore the ancient forest.



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 Guam Department of Agriculture, Forestry and Soil Resources Division to prevent wildfires in Guam. 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 prevention Identify ignition sources Explain how those ignition sources can create large scale wildfires Propose 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 Guam's wildfires and propose solutions to eliminate those sources.

Objectives

- Students will understand the difference between suppression and prevention
- Students will identify ignition sources
- Students will explain how those ignition sources can create large scale wildfires
- Students will propose solutions to prevent wildfires

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 Guam. 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 Guam are caused by humans! (include # of fires in the last year, show pictures of burned areas). Teacher will show the Guam Forestry Facebook post from the Leo Palace fire in 2018.
 3. Teacher will lead a class discussion of the following image, asking: “What do you notice about the hashtags?”



4. Teacher will have students create a Venn Diagram on their paper with “Suppression” on one side and “Prevention” on the other. Students will read the following article: https://www.postguam.com/news/local/marked-one-of-guam-s-worst-fire-seasons/article_3e80d20a-2673-11e7-ad0e-9bc4e834881b.html. 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?



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 SLOW DOWN THE PROGRESSION OF FIRE BUYING FIREFIGHTERS TIME TO RESPOND.

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 GUAM FIRE DEPARTMENT OR GUAM FORESTRY DIVISION 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. BUT EACH TIME, THE IMPACT OF THE WILDFIRE IS GREATER AND GREATER.

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.

2016 marked one of Guam's worst fire seasons

Wildfire preventative measures urged in local communities

Tihu Lujan | The Guam Daily Post
Apr 23, 2017

Last year marked one of Guam's worst for wildfires, ravaging a whopping 8,000 acres of Guam land throughout 2016, said Christine Fejeran, Cooperative Fire Program manager.

With the amount of acreage that burned last year – approximately 6.2 percent of the entire island, Fejeran noted – the Department of Agriculture's Forestry and Soil Resources Division has launched a series of outreach events and "Fire-wise" campaigns during this year's dry season.

"We need to start looking at wildfire as a threat on the island," Fejeran said. "We have for many years distanced ourselves from that threat, but many of the island's villages have really felt the impact of wildfires in the last two years. Last year was the worst fire season we've had in decades."

Last year saw about 770 wildfires over the course of the year, albeit some covering areas as small as a quarter of an acre.

However, four large-scale wildfires – Class E, Fejeran explained – accounted for a majority of Guam's land that burned last year, covering about 2,617 acres combined, she said.

So far, this year's dry season has seen 1,657 acres of Guam land burn as of April 13, according to Guam Forestry records. That's approximately 1.2 percent of Guam, Fejeran said.

Fighting fires

With a staff of 12, including Fejeran, DOA's forestry fire crew in partnership with the Guam Fire Department have worked together to put out these fires over the years, spending whole days and nights at times extinguishing flames and hosing down acres of land.

Recently firefighters have fought a slew of fires as the dry season rages on. Fejeran's crew fought against blazes on April 13 in Santa Rita, spending nearly 12 hours guzzling down thousands of gallons of water across 550 acres within a southern valley near LeoPalace.

The next day, on April 14, the Forestry crew again battled another wild grassfire that razed more than 30 acres of Barrigada land.

However, more needs to be done to prevent these fires rather than just reacting to them, Fejeran said.

With the dry season ongoing and a year ahead of one of Guam's worst fire seasons, Fejeran cautioned that more funding and resources needed to be allotted for wildfire preventative education in contrast to just suppressing the fires when they happen.

"We really do need to start looking long-term for wildfire," Fejeran said. "We've been fortunate that we haven't lost the number of homes that other jurisdictions have seen. Since last year was the worst season I've ever seen and apparently the worst for the veteran team members, we need to do something about it."

Prevention versus suppression

Fejeran also said funding preventative efforts would result in saving thousands of dollars, covering promotional items versus the cost of personnel required to extinguish completely preventable fires.

When a wildfire occurs, Fejeran explained that agencies take into account hazardous pay, overtime pay, night differential pay, medical services, auto fuel, protective gears, uniforms and, not to mention, thousands of gallons of water.

"There are all of these costs that we need to think about when we talk about fire suppression, and that's why prevention is number one for us," Fejeran said. "All of these costs associated with a fire, whether they're direct or the byproduct, it all adds up. If we can stop putting all of our resources into suppression and into prevention, the cost savings are huge."

Educating residents on establishing firebreaks near brush or by providing some sort of access to inland areas near their homes is one

preventative measure Fejeran said would make a big difference in the event of a wildfire.

“The protection that firebreaks add help secure a community where houses would now have an added chance against a wildfire,” Fejeran said. “The alternative is if you don’t give access or provide a break, we lose a home or multiple homes.”

Another risk residents need to prepare for is something that might not seem like an immediate problem at first, Fejeran said. Ash and embers billowing from a fire can easily spread to nearby homes via strong winds within at least a 2-mile radius.

These byproducts of fire are cause for concern, she said, especially for residents living in a non-concrete structure or with a canopy in their yard.

“People might not see the fire and it might not directly impact them right then and there, but if ash and embers are blowing toward you, you’ve got a 2-mile radius to worry about.”

Educational outreach

Fejeran also stressed the importance of reaching out to the community, schools and residents in order to share insights related to starting wildfires.

For those who don’t know, “All of Guam’s wildfires are caused by people,” Fejeran said. Arson and fires accidentally or intentionally caused by poaching account for the island’s large amount of wildfires.

Educating villages and schools about their potential contributions to wildfires as well as preventative measures could go a long way to ensure Guam experiences less completely preventable wildfires, Fejeran said.

“We’re taking action now for the community to think about these fire threats,” Fejeran said. “It’s a matter of getting more people interested in participating in prevention and helping minimize the threats to be more resilient against wildfire.”

While this year’s dry season remains more wet than last year’s season, intermittent weather mixed with strong winds could account for a potential wildfire at any time, Fejeran said.

As the dry season continues through June, Guam Forestry urges residents to be aware of looming wildfire threats, and to plan against potential threats accordingly.

“The goal is to get residents and their neighbors to look at fire as a common threat, a threat that should unify us,” Fejeran said. “It’s good for a house or a family to think about this, but to spread it across the street and then across the village can help us become more fire-wise residents and a fire-adapted community.”

Supplemental Resources for Posters:

- Trash Burning Permit: <https://www.govguamdocs.com/gfd/docs/BurningPermit.pdf>
- Burning trash: <https://smokeybear.com/en/prevention-how-tos/backyard-debris-burning>
- Campfire/Bonfire: <https://smokeybear.com/en/prevention-how-tos/campfire-safety/how-to-maintain-and-extinguish-your-campfire>

Sources:

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

Link to Original Guam Daily Post Article:

https://www.postguam.com/news/local/marked-one-of-guam-s-worst-fire-seasons/article_3e80d20a-2673-11e7-ad0e-9bc4e834881b.html

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 Guam's land cover contributes to the large amount of fires.

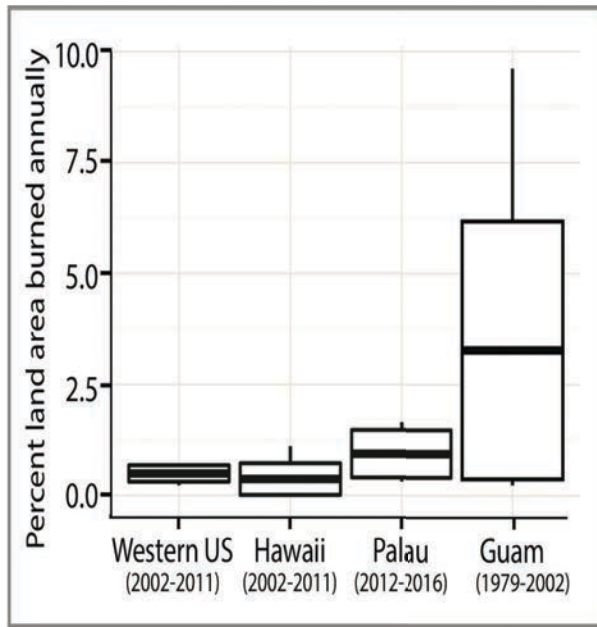


PHOTO SOURCE: PACIFIC FIRE EXCHANGE

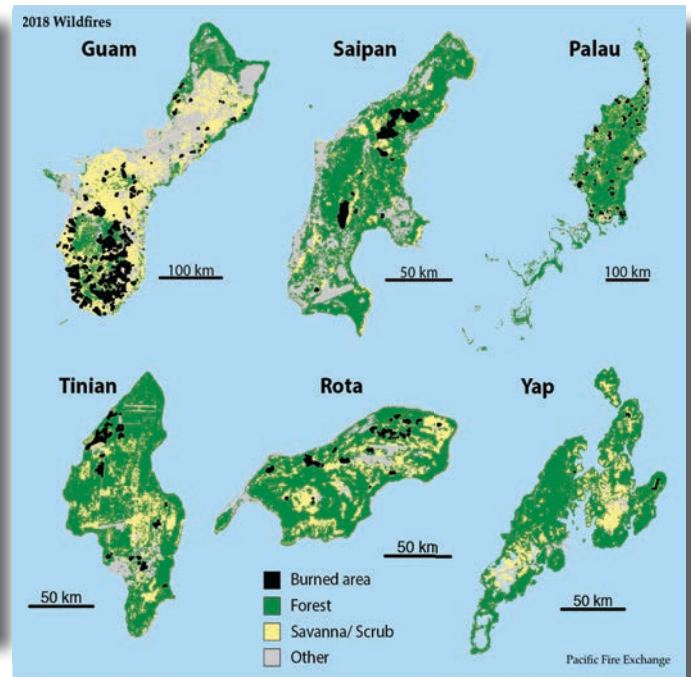
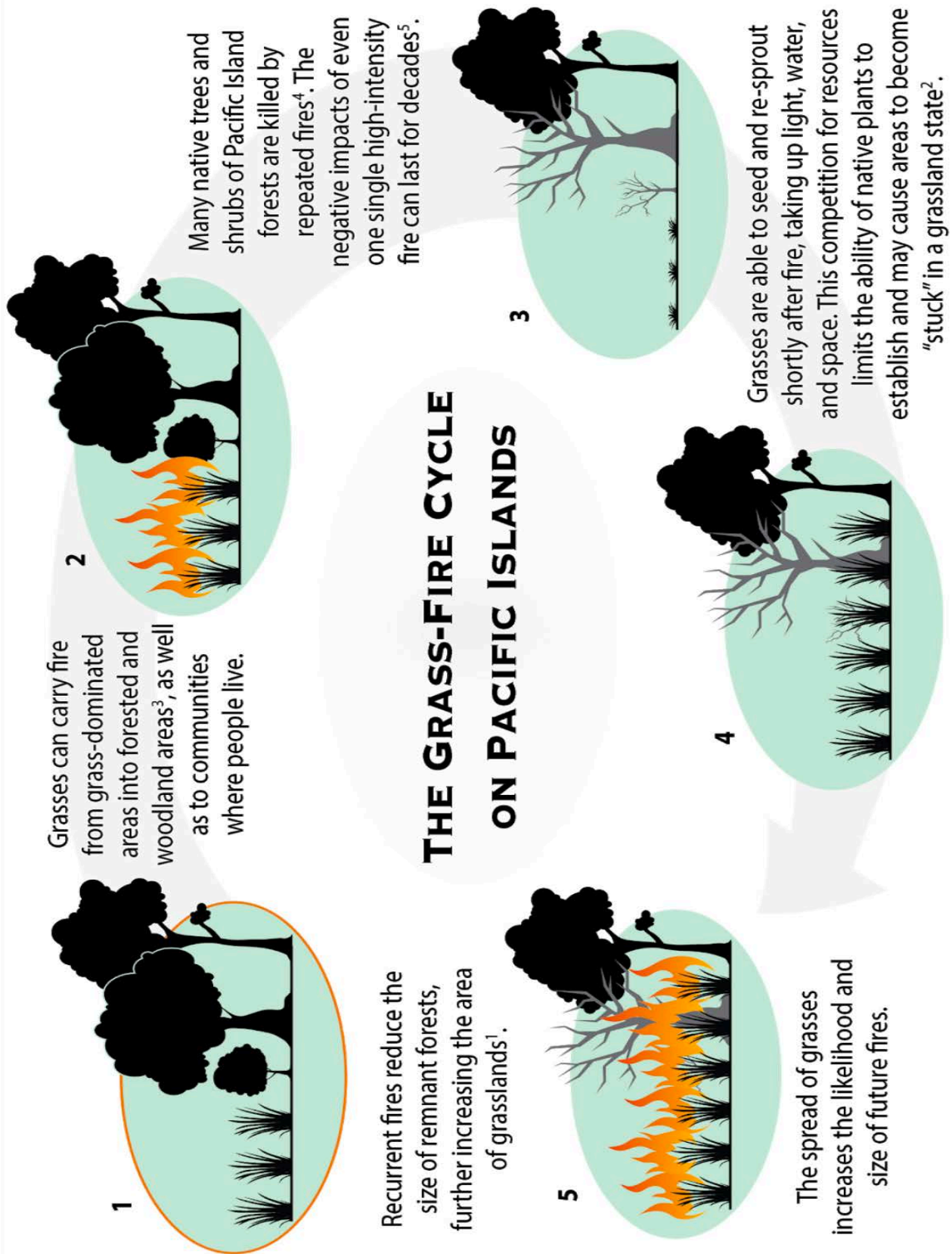


PHOTO SOURCE: PACIFIC FIRE EXCHANGE

- 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://static1.squarespace.com/static/54825edae4b0426dc2c78f10/t/5baaaf88652dea0abd827e68/1537912715371/PFX_FactSheet_GFCycle_Final.pdf)CITE PFX HERE Students will read over the handout, and will take notes on the land use management strategies.
- 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/perform the PSA next class.
- Students will take notes on each performance. They will write 1-3 concepts they either learned or were reinforced during the PSAs.



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 GUAM 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 GUAM.	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 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”: <http://www.trpa.org/wp-content/uploads/Living-With-Fire-Lake-Tahoe.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 Guam). Students will teach the class about their zone. Students will take notes on the presentations for each zone.



*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.



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 Guam.

Procedures

1. Bell ringer: Why is it important for us to prevent wildfires on Guam? 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-bjKOx3rlt75UGdPKBdk2mtlGzcrY/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 Guam. 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 Guam 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

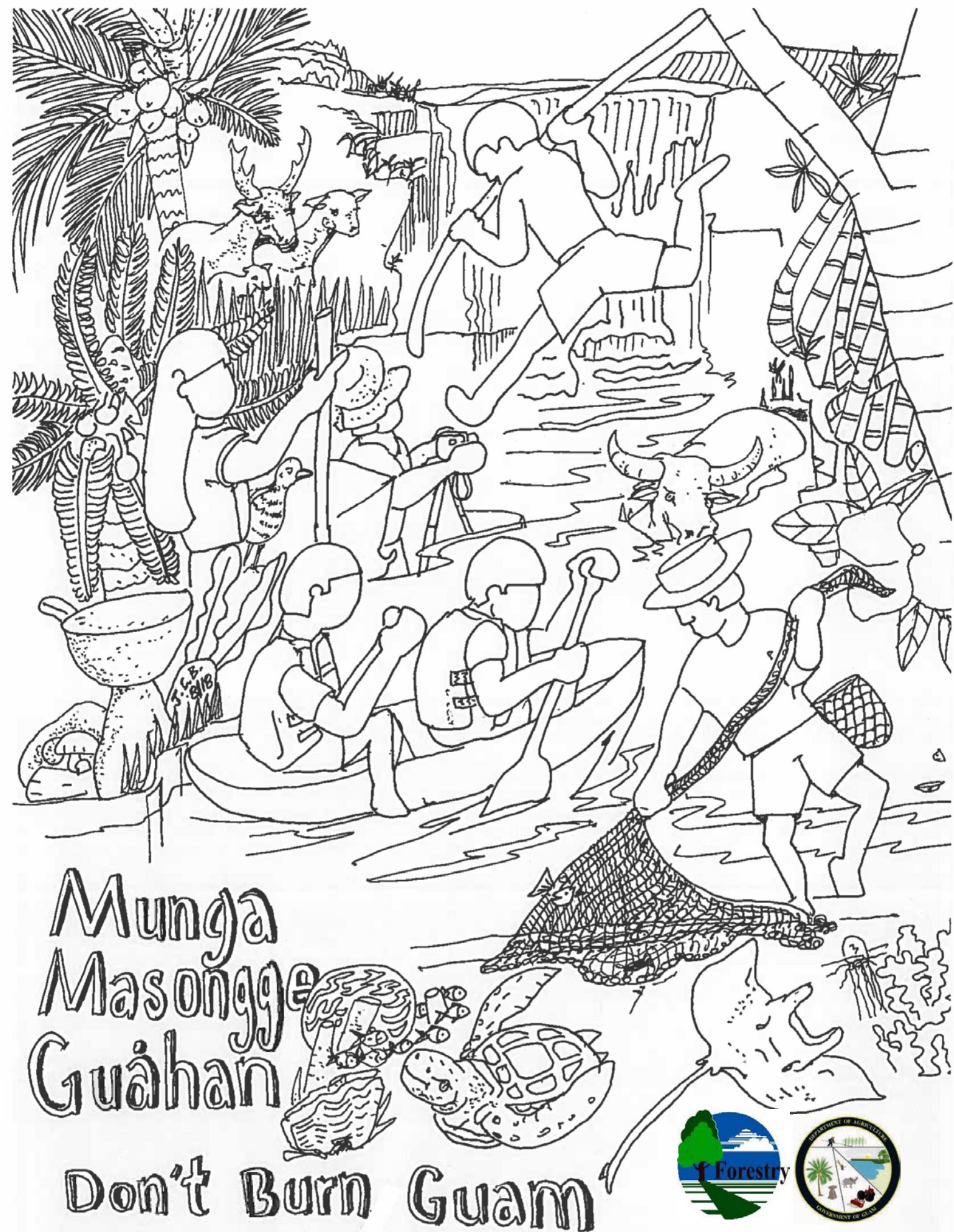
Class Presentation:

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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Wildfire Awareness Curriculum, Guam



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