



Teaching Change Curriculum
Developed for Pu'u Maka'ala Huaka'i
with the National Ecological Observatory Network



Introduction

How to Use this Module

This module was created to guide Teaching Change Field Courses at Pu'u Maka'ala Natural Area Reserve. The accompanying curriculum can be adapted and used to accompany any excursion

Themes

Ecosystem Dynamics,
Phenology, Climate
Change, Hawaiian
Perspectives on
Biocultural Resource
Management

NGSS Connected

Nā Hopena A'o
Connected

Students will....



Improve their understanding of climate change globally and locally, focusing on impacts and the role of data collection in remediation efforts.



Engage Hawaiian values, perspectives and practices to understand their environment and connect to place.

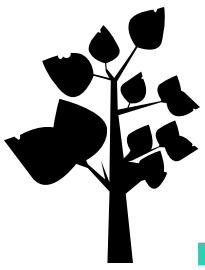


Learn how to use applied statistics to interpret NEON data.



Complete and present on a final project to create a management plan for Pu'u Maka'ala by merging Western and Hawaiian knowledge systems.





Unit Description

A Changing Climate in the Hawaiian Wet Forest: Pu'u Maka'ala

Student Learning Objectives

1 SLO 1

Define phenology and describe how it can be used to track environmental change (e.g. climate change).

2 SLO 2

Understand that phenology is important to people and cultures, the environment and natural resource management.

3 SLO 3

Define and identify native, endemic, indigenous, non-native, introduced, and invasive species.

4 SLO 4

Understand the rate at which the climate is changing today, and how current climate change relates to past climate change.

5 SLO 5

Recognize the threats to native Hawaiian forest ecosystems and the organisms that reside there and how applied management, including biocultural resource management is used to confront these threats.

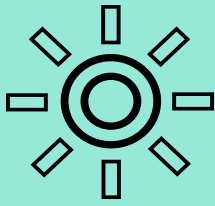
6 SLO 6

Recognize how data plays a role in understanding and managing our natural ecosystems

7 SLO 7

Increase awareness of educational and career opportunities in natural resource management in Hawai'i

Essential Questions



Climate

How could climate change impact Pu'u Maka'ala?



Data

How does NEON use observation to collect data and information on the Pu'u Maka'ala ecosystem?



Information

What data and information can you collect at Pu'u Maka'ala?



Knowledge

How can Hawaiian and Western Knowledge systems merge to inform management decisions for Natural Area Reserves?



Community

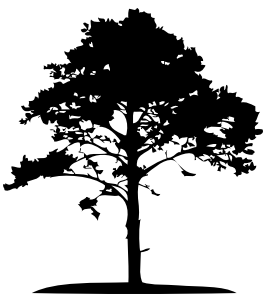
How can community and culture inform management decisions for Natural Area Reserves?



Science

How can we use scientific data to make connections or reasoning to influence our actions and prevent future impacts?





NGSS

Disciplinary Core Ideas

HS-ESS2-4 Earth's Systems

- **ESS1.B: Earth and the Solar System**

Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes.

- **ESS2.D: Weather and Climate**

The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.

HS-ESS3-2 Earth and Human Activity

- **ESS3.A: Natural Resources**

All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors.

- **ETS1.B: Developing Possible Solutions**

When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

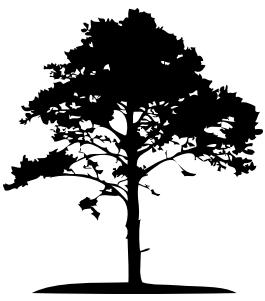
HS-ESS3-4 Earth and Human Activity

- **ESS3.C: Human Impacts on Earth Systems**

Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.

- **ETS1.B: Developing Possible Solutions**

When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
(secondary)



NGSS

Cross Cutting Concepts

Cause and Effect

- **(HS-ESS2-4)** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Stability and Change

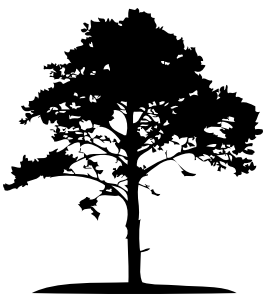
- **(HS-ESS3-4)** Feedback (negative or positive) can stabilize or destabilize a system.

Connections to Nature of Science

- **(HS-ESS2-4) Scientific Knowledge is Based on Empirical Evidence**
Science arguments are strengthened by multiple lines of evidence supporting a single explanation.
- **(HS-ESS3-2) Science Addresses Questions About the Natural and Material World**
Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions.
Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.
Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues.

Connections to Engineering, Technology, and Applications of Science

- **(HS-ESS3-2) Influence of Science, Engineering, and Technology on Society and the Natural World**
Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.
Analysis of costs and benefits is a critical aspect of decisions about technology.
- **(HS-ESS3-4) Influence of Science, Engineering, and Technology on Society and the Natural World**
Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.



NGSS

Science & Engineering Practices

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). (HS-ESS2-4)

Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). (HS-ESS3-2)

Design or refine a solution to a complex real-world problem based on scientific knowledge, student generated sources of evidence, prioritized criteria and tradeoff considerations. (HS-ESS3-4)

Na Hopena A'o

Strengthened sense of Belonging:

Students will work in teams to investigate and present on their research. Their research is grounded in place-based education at a local Natural Area Reserve, Pu'u Maka'ala. We will refer to the value of lōkahi, or teamwork, collaboration, cooperation, reciprocity and trust to strengthen relationships between one another as students and between themselves and place.

Strengthened sense of Responsibility:

Students will be guided in their learning process and engagement will be facilitated. However, students will be encouraged to take initiative in their own learning. Peer to peer review will also be facilitated to strengthen sense of kaiāulu (community) and kuleana (responsibility).

“Great teachers show you where to look, but not what to see.”

Strengthened sense of Excellence:

Students will set personal goals for success and team objectives for reaching project goals.

Strengthened sense of Aloha:

Lōkahi (value of teamwork) and laulima (working together) will be major themes for students in their working as a group to develop presentations and complete their projects.

Strengthened sense of Total Well Being:

Students will work in a challenging environment and are likely to face adversity in the form of rain and cool weather. Students will be managing their projects in line with multiple school obligations. Students will learn to manage their time and learn how to promote well being amongst themselves and others by being thoroughly prepared and thinking ahead.

Strengthened sense of Hawai‘i:

Students will learn in a place-based setting, with Hawaiian language and terms incorporated into their work. Student projects will aim to connect students to place, and deepen a human-nature connection. Students will be encouraged to engage in aloha ‘āina (love for the land), mālama ‘āina (caring for the land) and mālama honua (caring for the earth) with the goal of students engaging in environmental stewardship for life.



Course Description

01

Lesson 1

Orientation and Introductions:

What is climate change, phenology and who is NEON?

Objectives: Introduce topics, key players, and important information needed for the first Field Course. Introduce Final Project.

Two Hours

02

Lesson 2

First Field/Virtual Field Course to Pu'u Maka'ala

Objectives: Introduce Hawaiian wet forest ecosystems, native flora and fauna, NEON technology field methods and sampling, phenology, environmental threats and mitigation.

8 hours

03

Lesson 3

Environmental Threats to Natural Area Reserves

Objectives: Students learn what threats ecosystems face including climate change, invasive species, pollution, natural and anthropogenic threats.

60 Minutes

04

Lesson 4

Climate and Data Analysis

Objectives: Understand how information and data can be analyzed using statistics. Understand how we would use statistics to analyze phenology and climate data at Pu'u Maka'ala and around the world.

60 Minutes

05

Lesson 5

Career Connected Learning and Project Preparations

Objectives: Discover local careers and career paths in Natural Resource Management in Hawai'i. Become familiar with processes such as college applications, FAFSA applications, and internships in Hawai'i. Discuss actions and behavior to engage in any career that can support mālama 'āina.

60 Minutes



Course Description

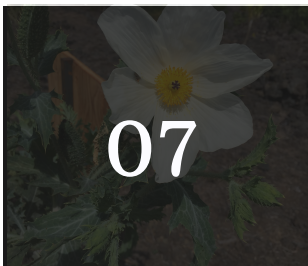


Lesson 6

How to Present Science to Community Audiences

Objectives: Learn the foundations of developing a professional presentation. Learn how to share scientific information to any audience.

60 Minutes



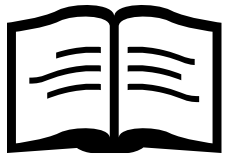
Lesson 7

Community Presentations

Objectives: Students share their management plan with a community audience and answer questions related to natural resource management.

60 Minutes





Lesson One

Orientation and Introduction

NGSS Focus:

HS-ESS2-4

HS-ESS3-2

SLO Focus:

1, 2, 3, & 4

Topics

Ecosystem Dynamics, Phenology, Climate Change, Hawaiian Perspectives on Biocultural Resource Management

Objectives

Have students become familiar with general concepts, vocabulary and be prepared for embarking on a Field Course.

Materials

- Intro presentation: Teaching Change-NEON
- Reading: Nā Hopena A'o
- Reading: Pu'u Maka'ala NARS
- Pre-assessment
- Field Notebooks

Nā Hopena A'o Focus

Strengthened Sense of Belonging

1. Know who I am and where I am from.
2. Build relationships with many diverse people.
3. Care about my relationships with others.
4. Open to new ideas and different ways of doing things.
5. Communicate with clarity and confidence.
6. Understand how actions affect others.
7. Actively participate in school and communities.

Tasks

- **Students will be introduced** to important themes and relevant terms such as climate vs. weather, local and global climate change, climate change historically and contemporarily, anthropogenic and natural drivers of climate change and how location influences climate.
- **Students will learn** the difference between native and non-native species.
- **Students will learn** that ecosystems are dynamic systems that are in constant flux.
- **Students will learn** the definition and use of phenology, and its applicability to climate change research.
- **Students will be introduced** to NEON (National Ecological Observation Network) and Pu'u Maka'ala, their methods for collecting data and their mission. Final project concept and requirements will be introduced.

Presentation: [NEON-Teaching Change Intro](#)

Review: [Handout: Nā Hopena A'o](#) as a guideline for this project.

Readings: [Nā Hopena A'o](#) & [Pu'u Maka'ala NARS](#)

Lesson One

Background Information



Phenology Introduction for Teachers:

How does an ‘Ōhi‘a know when to blossom? How does an ‘I‘iwi know when to build its nests? How does a Wiliwili tree know when to shed its leaves? How does the humpback whale determine when to travel from Alaska to Hawai‘i? Do they check a calendar or their watches? Of course not! They take cues from their environment. Temperature, rainfall, seasons and day length are all signals for plants and animals. For example, when new leaves bud, when insects emerge, or when animals reproduce are all various stages in the life cycle, (called phenophases) and the study of life cycle stages called phenology.

Phenology is the link to all organisms on the planet. Ultimately, phenology plays a major role in controlling the abundance, distribution and biodiversity of species on Earth, and the ecosystem goods and services that these natural systems provide (e.g., the water and carbon cycles). Phenology is a great tool to use in biocultural resource management. There are many traditional Hawaiian sayings like, “Pua ke kō, kū ka he‘e” (When the sugar cane tassels, the octopus season is here) or “Pua ka neneleau, momona ka wana” (When the neneleau blooms, the sea urchin is fat). Observations of phenophases over many generations created these traditional sayings. There are even local festivals that revolve around phenophases, for example, the Cherry Blossom Festival.

Phenology in its simplest terms means the study of appearance; it comes from the Greek word “phaino” (to show or appear) and logos (to study). In recent years, interest has increased in the scientific community to better document the connection between phenological events such as flowering, migration, reproduction and climate change. The better one’s understanding of phenology, the better their understanding of the environment.

Climate Change and Phenology:

Earth’s climate is changing, as it has since the beginning of time. The primary difference between what is occurring today vs. past climate change is the rate at which the climate is changing. In the past, climate change was caused by the Earth’s orbit or what is known as the Milankovitch cycles. Changes in Earth’s orbit, tilt, and axial wobble have led to relatively predictable changes in our planet’s climate on the scales of 10,000s to 100,000s of years. Today, the Earth’s climate is changing rapidly as the result of human activities such as the burning of fossil fuels and land use change (eg. deforestation) which amplify Earth’s natural greenhouse effect. Greenhouse gases produced by humans, such as carbon dioxide,

Lesson One: Phenology Introduction for Teachers

methane, and nitrous oxide, all contribute to the greenhouse effect by trapping heat from the sun (Global Climate Change, 2008). Since the Industrial Revolution began, carbon dioxide levels have increased by more than one third (Global Climate Change, 2008). In turn, high concentrations of greenhouse gases are already altering Earth by increasing global temperatures in the atmosphere and sea, causing increased extreme weather events, and increasing sea levels (Global Climate, Change 2008., Cunningham & Cunningham, 2018).

Since phenophases take their cue from the environment, climate change is also impacting the phenology of plants and animals. For example, scientists are discovering that spring is coming earlier, and fall later. To make it more complicated, not all plants and animals are responding homogeneously (USA NPN, n.d.). For example, if leaf buds emerge earlier as a result of warming temperatures, that will also impact the emergence of insects which, in turn, will impact the breeding season for birds. If these changes in phenophases across organisms do not occur in concert, birds may have limited food for their hatchlings and a decreased survival rate. Being able to track phenology can help predict and prepare for the impacts of climate change on a number of natural resources helping to better our understanding of the environment.

Citizen Science and Phenology

Phenology and its relation to climate change is a global event and scientists are unable to be everywhere in the world at one time. Citizen science creates an opportunity for students to engage by making observations that will be beneficial for both themselves as students, and as scientists. By participating in citizen science, students have a chance to be part of the global scientific community, to feel a sense of importance, and to see science done in action. Teaching Change has partnered with the USA National Phenology network to provide phenology data on native Hawaiian plants that can someday aid scientists in more accurate monitoring and in predicting of droughts, wildlife risk, biological invasions and the spread of diseases.

Native and Non Native Species

Native species are plants and animals that occur naturally in an ecosystem, and historically arrived, or evolved from an ancestor who made it to that particular place on its own, without the help of humans. Native species arrived to Hawai'i by one of three ways; they came by ocean currents (swam or floated here), they came by winged creatures (they flew here, or hitched a ride in or on a winged creature), or they

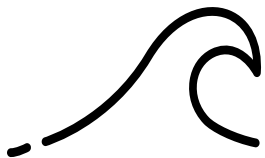
Lesson One: Phenology Introduction for Teachers

came here on wind currents (they floated or were blown here). In Hawai'i we call this the three M's or three W's. What are some examples of native plants and animals that came to Hawai'i via the three M's and three W's?

Species that are native are either endemic or indigenous. Endemic species are only found in that one place and nowhere else in the world, while indigenous species can be found in other places. Nēnē for example are a native bird species that live only in Hawai'i and nowhere else! Naupaka kahakai on the other hand is native to Hawai'i, but can also be found in other places like Tahiti.

Non-native species are plants and animals that were introduced to an ecosystem by humans, both intentionally, and unintentionally. Some reasons why people intentionally introduce plants and animals to a new place is because they are a source of food to eat or materials to make things, remind people of their homelands, or are pretty.

What are some examples of non-native plants and animals that were purposefully introduced by humans to Hawai'i? Some non-native species are considered invasive- these are plants and animals that cause harm to an ecosystem. Some plants such as canoe plants, are not native, but do not harm the ecosystem. This includes niu (coconut), mai'a (banana), and 'ulu (breadfruit).



Moana/Waves



Manu/Wings



Makani/Wind

Pu'u Maka'ala Natural Area Reserve (NAR)

Pu'u Maka'al is a Natural Area Reserve located in Keauhou on Hawai'i Island within the Moku of both Hilo and Puna, in the ahupua'a of both Waiākea and 'Ōla'a. Natural Area Reserves are areas established to preserve land and water which support communities, and to preserve geological and cultural sites of significance in perpetuity. There are eight Natural Area Reserves on Hawai'i Island: Mauna Kea Ice Age NAR, Kīpāhoehoe NAR, Manukā NAR, Kahauale'a NAR, Pu'u Maka'ala NAR, Waiākea NAR, Laupāhoehoe NAR, and Pu'u O 'Umi NAR. In the early 1900's, the land where Pu'u Maka'ala NAR currently is was determined to be of significance and worthy of protection. Between 1905-1928 the area was dedicated to public interest as a natural resource site. In the 1970's, it was proposed to be protected as a NAR, and in 1981 it was officially established.



Lesson Two

Field Course

NGSS Focus:

HS-ESS2-4
HS-ESS3-2
HS-ESS3-4

SLO Focus:

1, 2, 3, 4 & 5

Topics

Ecosystem Dynamics, Phenology, Climate Change, Hawaiian Perspectives on Biocultural Resource Management

Objectives

Apply vocabulary and concepts learned in lesson one during data collection tasks. Learn plant ID and phenology ID skills. Become familiar with environmental threats and Hawaiian ecosystems.

Materials

- Field Notebooks
- Backpacks
- Field Clothes and Rain Gear
- ROD Decontamination Supplies

Tasks

- **Students will explore** Pu'u Maka'ala plants, birds, and NEON equipment.
- **Students will be introduced** to field methods including phenology data collection and utilizing kilo (Hawaiian practice of observation) to understand their environment.
- **Students will learn** about NEON data collection methods for collecting climate data including soil data and atmospheric data.
- **Students will discuss** career connections during guided discussions.

Discuss and review: [Pu'u Maka'ala NARS](#).

Activity: [Pu'u Maka'ala Inoa Wahipana](#)

Assignment: Read the [Pu'u Maka'ala Biocultural Resource Management Plan Final Project](#)

Nā Hopena A'o Focus

Strengthened Sense of Hawai'i

1. Pronounce and understand Hawaiian everyday conversational words
2. Use Hawaiian words appropriate to their task
3. Learn the names, stories, special characteristics and the importance of places in Hawai'i
4. Learn and apply the Hawaiian traditional worldview and knowledge in contemporary settings
5. Share the histories, stories, cultures and languages of Hawai'i
6. Compare and contrast different points of views, cultures and their contributions
7. Treat Hawai'i with pride and respect
8. Call Hawai'i home



Lesson Two

Virtual Huaka'i

NGSS Focus:

HS-ESS2-4
HS-ESS3-2
HS-ESS3-4

SLO Focus:

1, 2, 3, 4 & 5

Topics

Ecosystem Dynamics, Phenology, Climate Change, Hawaiian Perspectives on Biocultural Resource Management

Objectives

Apply vocabulary and concepts learned in lesson one during data collection tasks. Learn plant ID and phenology ID skills. Become familiar with environmental threats and Hawaiian ecosystems.

Materials

- Pu'u Maka'ala NAR Virtual Tour
- Writing utensils
- Notebook

Tasks

- **Students will explore** Pu'u Maka'ala plants, birds, and NEON equipment.
- **Students will be introduced** to field methods including phenology data collection, utilizing kilo (Hawaiian value for observation) to understand your environment.
- **Students will learn** about NEON data collection methods for collecting climate data including soil data, atmospheric data.
- **Students will discuss** career connections during guided discussions

Watch: [Virtual tour of Pu'u Maka'ala NARS](#) (Link to video on Youtube)

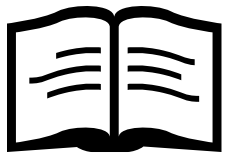
Activity: [Pu'u Maka'ala Inoa Wahipana](#) (Optional: [Kilo Worksheet](#))

Assignment: Read the [Pu'u Maka'ala Biocultural Resource Management Plan Final Project](#)

Nā Hopena A'o Focus

Strengthened Sense of Hawai'i

1. Pronounce and understand Hawaiian everyday conversational words
2. Use Hawaiian words appropriate to their task
3. Learn the names, stories, special characteristics and the importance of places in Hawai'i
4. Learn and apply the Hawaiian traditional worldview and knowledge in contemporary settings
5. Share the histories, stories, cultures and languages of Hawai'i
6. Compare and contrast different points of views, cultures and their contributions
7. Treat Hawai'i with pride and respect
8. Call Hawai'i home



Lesson Three

Environmental Threats

NGSS Focus:

HS-ESS2-4

HS-ESS3-2

SLO Focus:

1, 2, 4, & 5

Topics

Socio-ecological Systems, Threats to Hawaiian Ecosystems

Objectives

Students learn what threats ecosystems face including climate change, invasive species, pollution, natural and anthropogenic threats.

Materials

- Computer/laptop
- Excel with Data Analysis Package
- Pencil, pen

Nā Hopena A'o Focus

Strengthened Sense of Responsibility

1. See self and others as active participants in the learning process
2. Question ideas and listen generously
3. Ask for help and feedback when appropriate
4. Set goals and complete tasks fully
5. Reflect on the quality and relevancy of the learning

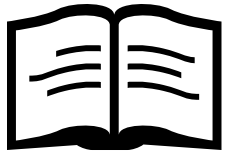
Tasks

- **Students will review** lesson one and focus on threats to ecosystems.
- **Students will learn** how data is used to make statements about the state of the environment.
- **Students will begin planning** their final projects.

Presentation: [Ecosystem Threats and NEON Data](#)

Activity: [“How to determine if two variables are correlated”](#)

Assignment: [Personal, Professional, and Project Group Goals Worksheet](#)



Lesson Four

Climate & Data Analysis

NGSS Focus:

HS-ESS2-4

HS-ESS3-2

SLO Focus:

1, 2, 5, 6, & 7

Topics

Climate Data and Data Analysis

Objectives

Have students understand how information and data can be analyzed using statistics, and how we would use statistics to analyze phenology and climate data at Pu'u Maka'ala and around the world.

Materials

- Computer/laptop
- Excel with Data Analysis Package
- Pencil, pen

Nā Hopena A'o Focus

Strengthened Sense of Responsibility

1. See self and others as active participants in the learning process
2. Question ideas and listen generously
3. Ask for help and feedback when appropriate
4. Set goals and complete tasks fully
5. Reflect on the quality and relevancy of the learning

Tasks

- **Students will lead an investigation** of correlations between climatic data (soil, air, temperature, rainfall, sunlight, phenology) from NEON data sets and in situ data collected (phenology, kilo observations).

Presentation: [NEON Data & Statistics PowerPoint](#) & [NEON Statistics Lesson](#)

Activity: [Climate and Data Analysis Discussion Prompts](#)

Readings: Read the [Pu'u Maka'ala Biocultural Resource Management Plan Final Project](#)

Lesson Four

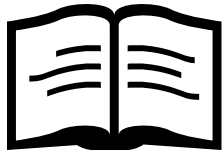
Climate and Data Analysis

Discussion Prompts



Following the NEON Statistics Lesson, create breakout groups and facilitate discussion around the following questions.

- 1 Which area out of the three presented receives the most rain and why?
- 2 Which area has the largest range of photosynthetically active radiation and why?
- 3 What relationship do you see between temperature and open 'ōhi'a flowers, as well as rain and open 'ōhi'a flowers? What concerns might this make you think of with climate change?



Lesson Five

Career Connections & Project Prep.

NGSS Focus:

HS-ESS2-4
HS-ESS3-2

SLO Focus:

1, 2, 5, & 7

Topics

Career connected learning, professional pathway development guidance, how to green your job, developing solutions to real world problems

Objectives

Discover local careers and career paths in Hawai'i in Natural Resource Management. Become familiar with college applications, FASFA applications, and internships in Hawai'i. Discuss actions and behavior to engage in any career that can support mālama 'āina.

Materials

- Laptops/computers
- Poster paper
- Markers/colored pencils/crayons

Nā Hopena A'o Focus

Strengthened Sense of Total Well Being

1. Feel safe physically and emotionally
2. Develop self discipline to make good choices
3. Manage stress and frustration levels appropriately
4. Have goals and plans that support healthy habits, fitness and behaviors
5. Utilize the resources available for wellness in everything and everywhere
6. Have enough energy to get things done daily
7. Engage in positive social interactions and have supportive relationships
8. Promote wellness in others

Tasks

- **Students will be challenged** to think about future careers and potential pathways to them.
- **Students will brainstorm** on how to “green your job” to learn how everyday businesses can do their part to protect biocultural resources.
- **Students will ask questions and receive guidance** from instructors. regarding their final projects and begin preparing for their final presentation.

Presentation: [Professional Pathways to STEM Careers](#)

Activity: Discuss and answer questions in the:

- [Personal & Professional Goals Worksheet](#)
- [Project & Group Goals Worksheet](#)

Readings:

- [Management Policies of the Natural Area Reserves System](#)
- [Pu'u Maka'ala Biocultural Resource Management Plan Final Project](#)



Lesson Five

Personal & Professional Goals

Worksheet



- 1 What is your dream career? What are your intentions? What approach will you take to get there? What are your plans, dreams and goals for beyond high school?
- 2 What will you be doing for the next five years after high school? The next ten years after high school? Do you have an action plan to achieve your goals?
- 3 If you plan to attend college, what is your financial plan to cover expenses?
- 4 What are steps you can take between now and your graduation to support your five year plan? Your ten-year plan?
- 5 What does success look like to you in your personal and professional goals?
- 6 What unique gifts and abilities do you have that you will be able to offer your future colleagues?
- 7 How do you plan to prioritize and manage your time well in order to achieve your goals?

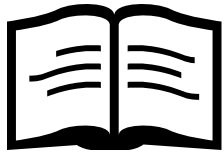
Lesson Five

Project & Group Goals

Worksheet



- 1 What professional skills would you like to work on during this project?
Writing, using excel, public speaking, teamwork, communication?
- 2 What is your goal as a group in this project? Does your team wish to practice general professional skills such as public speaking? Does your team wish to work on STEM-specific goals such as learning field methods in natural resource management?
- 3 What do you hope to convey to your audience during your presentation?
- 4 What will your group work towards to consider your project a success?
- 5 What unique gifts and abilities can each of your team members contribute to your group?
- 6 How does your group plan to prioritize time and energy well to balance your group project with other responsibilities?
- 7 Are there opportunities for you to take initiative without being asked?



Lesson Six

Presenting Science to Community Audiences

NGSS Focus:

HS-ESS2-4
HS-ESS3-2
HS-ESS3-4

SLO Focus:

1, 2, 5, & 7

Topics

Developing a professional presentation, science communication

Objectives

Learn the foundations of developing a professional presentation. Learn how to share scientific information to any audience.

Materials

- Computers/laptops
- Internet
- Microsoft Powerpoint

Nā Hopena A'o Focus

Strengthened Sense of Excellence

1. Define success in a meaningful way
2. Know and apply unique gifts and abilities to a purpose
3. Prioritize and manage time and energy well
4. Take initiative without being asked
5. Explore many areas of interests and initiate new ideas
6. Utilize creativity and imagination to problem-solve and innovate
7. See failure as an opportunity to learn well
8. Assess and make improvements to produce quality work

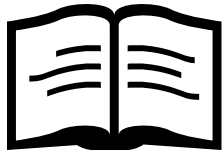
Tasks

- **Students will begin crafting** their final project powerpoint presentation.
- **Students will learn** how to deliver scientific information to the community.
- **Students will be advised** on how to create an impactful and easy to follow presentation keeping in mind their audience.

Presentation: [How to Present Science to Community Audiences](#)

Assignment: Continue to develop final projects

Readings: [Pu'u Maka'ala Biocultural Resource Management Plan Final Project](#)



Lesson Seven

Student Presentations

NGSS Focus:

HS-ESS2-4
HS-ESS3-2
HS-ESS3-4

SLO Focus:

1, 2, 5, & 7

Topics

Oral speaking, science communication

Objectives

Students will share their management plan with a community audience and answer questions related to natural resource management.

Materials

- Projector
- Computer with presentations
- Microphones

Nā Hopena A'o Focus

Strengthened Sense of Belonging

1. Know who I am and where I am from
2. Build relationships with many diverse people
3. Care about my relationships with others
4. Be open to new ideas and different ways of doing things
5. Communicate with clarity and confidence
6. Understand how actions affect others
7. Actively participate in school and communities

Tasks

- **Students will deliver** their presentations to the community.
- **Students will answer questions** related to their project topic and natural resource management.
- **Students will learn** to give and receive constructive feedback.

Assignment: Peer review fellow student's presentations

Final Projects

Create A Natural Area Reserve Management Plan



Directions: Use the information you have learned in class, the notes you've taken during lessons, and research you've done on your own to inform your decisions about management tactics for one of the following topics:

1. Pick a topic for your group:

1. Native Plant Protection
2. Invasive Species Control
3. Cultural Resource Management
4. Monitoring & Restoration
5. Education and Outreach

2. Research into the following questions for your topic:

- What management has been currently proposed for your topic? Will you include these ideas in your management plan and why?
- What research has been done on your topic? Do you plan to incorporate this into your management plan and how?
- Do you need to conduct new research on your topic? Develop new research questions for your topic to investigate.
- What type of resources exist to support your management proposal? Do you need to make or acquire new resources and information to aid your decisions? (example- maps of the area)

3. Develop your management plan:

Structure your management plan as follows:

1. Problem
2. Approach
 - a. Research
 - b. Data Collection
 - c. Collaborate
 - d. Develop
3. Conclusions

4. Create your presentation in sync with your fellow classmates and other groups.

Native Plant Protection

1. Problem:

- Define the problems that native, endemic and rare plants face at Pu'u Maka'ala. What rare, endemic and native plants occur here? What are the status of some of the plants on IUCN's red list (endangered, threatened)? What are the threats to these native plants? How are the general populations of these plants doing throughout the rest of the state?

2. Approach:

• Research:

- What research do you need to conduct to get relevant information on the native plant species at Pu'u Maka'ala? What resources already exist? What climate data from NEON do you need to investigate for the health of native plants?

• Data collection:

- What data do you need to collect in situ (data at the field site)? Will you document plants by photograph ID? Will you inventory and catalog plants in the forest? What materials and equipment do you need? Is there a map that already exists?

• Collaborate:

- What other group(s) do you need to talk to about native plant protection?

• Develop:

- What is your plan, based on your research to protect the native species at Pu'u Maka'ala?

3. Conclusion:

- What do you predict may be the outcome of native species at Pu'u Maka'ala without a management plan?

Invasive Species Control

1. Problem:

- Define the problem: Why do we need to manage invasive plant and animals species? What plant and animal species are a threat to Pu'u Maka'ala? Are there endangered or threatened species at Pu'u Maka'ala that need protection?

2. Approach:

- **Research:**

- What research do you need to conduct to get relevant information on the invasive species at Pu‘u Maka‘ala? What resources already exist? What climate data from NEON do you need to investigate that may be related to invasive species?

- **Data collection:**

- What data do you need to collect in situ (data at the field site)? Will you need to document via photograph? What materials and equipment do you need? Is there a map of invasive threats that already exists?

- **Collaborate:**

- What other group(s) do you need to talk to about invasive species control?

- **Develop:**

- What is your plan, based on your research to reduce the impact of invasive species at Pu‘u Maka‘ala?

3. Conclusion:

- What do you predict may be the outcome at Pu‘u Maka‘ala without a management plan regarding invasive species?

Cultural Resource Management

1. Problem:

- Define the problem: What considerations does a management plan need to take regarding cultural resources? What resources occur here that could be used for cultural purposes? What traditions and rituals are these resources used for? Are any of these resources used for medicinal purposes by Hawaiians? What mo‘olelo accompanies these resources?

2. Approach:

- **Research:**

- What research do you need to conduct to get relevant information on the cultural resources at Pu‘u Maka‘ala? What resources already exist? What climate data from NEON do you need to investigate for the health of the cultural resources at Pu‘u Maka‘ala?

- **Data collection:**

- What data do you need to collect in situ (data at the field site)? Will you document plants by photograph ID? Will inventory and catalog plants in the forest? What materials and equipment do you need? Is there a map that already exists?

- **Collaborate:**

- What other group(s) do you need to talk to about cultural resource protection?

- **Develop:**

- What is your plan, based on your research to protect the cultural resources at Pu'u Maka'ala?

3. Conclusion:

- What do you predict may be the outcome for cultural resources at Pu'u Maka'ala without a management plan?

Monitoring and Conservation

1. Problem:

- Define the problem: What environmental elements need to be monitored at Pu'u Maka'ala? What is already being monitored? Should we add additional parameters to monitor? What will the data collected be used for? How can we use NEON data to inform conservation decisions?

2. Approach:

- **Research:**

- What research do you need to conduct to get relevant information on the monitoring at Pu'u Maka'ala? What resources already exist? What data from NEON do you need to analyze?

- **Data collection:**

- What data do you need to collect in situ (data at the field site) for analysis? Are there specific data you would like the other groups to collect? Will you need to document Pu'u Maka'ala by photograph? What materials and equipment do you need? Is there a map that already exists?

- **Collaborate:**

- What other group(s) do you need to talk to about monitoring and conservation?

Final Projects: Natural Area Reserve Management Plan

- **Develop:**

- What is your plan, based on your research for monitoring and conservation efforts at Pu'u Maka'ala?

3. Conclusion:

- What do you predict may be the outcome at Pu'u Maka'ala without monitoring and conservation efforts included in the management plan?

Outreach and Education

1. Problem:

- Define the problem: Why is it important to include the community in Natural Area Reserves? How do they get access and become aware of this information?

2. Approach:

- **Research:**

- What research do you need to conduct to get relevant information on the existing education and outreach efforts for Pu'u Maka'ala? What resources already exist? What resources need to be made? Based on your research, what are some effective ways to reach out to people to raise awareness about conservation efforts?

- **Data collection:**

- What data do you need to collect in situ (data at the field site)? What data can you use from NEON to develop education and outreach plans? Will you need to document with photographs for educational material? What materials and equipment do you need? Is there a map that already exists?

- **Collaborate:**

- What other group(s) do you need to talk to about education and outreach?

- **Develop:**

- What is your plan, based on your research to promote education and outreach for Pu'u Maka'ala?

3. Conclusion:

- What do you predict may be the outcome at Pu'u Maka'ala without including education and outreach in their management plan?