

Pago Pago Harbor: The Effects of Streams on its Health and Development

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## Abstract

This paper consists of a unit plan with a focus on the place- based education curriculum. It centers on many aspects of the streams in the village of Pago Pago that include water quality, water organisms, plants, pollution, erosion and the restoration of mangroves. The rigorous lessons place much emphasis on STEM education in the areas of science, technology, engineering and mathematics with the integration of other content areas. Community involvement is also enforced and appreciated in the planning of the lessons such as parents, elders, and scientific experts.

*Keywords:* (stream, water quality, stream animals, stream plants, population growth, pollution, stream filtration, mangroves.)

*Pago Pago Harbor: The Effects of Streams on its Health and Development*

We are from Pago Pago and have seen the changes over the years caused by population growth, deforestation, and pollution. The Place-Based class has taught us the importance of identifying the problems and finding solutions by reaching out to the community. Implementing the lessons and putting into action will be beneficial for the future generation. The future generation will MAKE the change.

**Standards and Benchmarks**

American Samoa Standards, 2011

**Science**

**Standards and Benchmarks**

Physical Science

Standard 1: Students inquire about states, properties, and transformations of matter.

- 5.1.3: Investigate and distinguish between physical and chemical changes that occur to various substances in everyday situations

Standard 2: Students explain forces, motions, and their interactions.

- 5.2.1: Analyze, measure, and predict motion as a consequence of the multiple balanced or unbalanced forces acting in a system.

**EARTH & SPACE:**

Standard 5: Students explain planet Earth as a complex and dynamic system of rock, water, air, and living things.

- 5.5.1: Cite evidence of mechanisms and processes that have shaped the Earth system
- 5.5.2: Analyze the components and interactions of the Earth system

Standard 6: Students assess the interrelated cycles and forces that shape Earth's surface,

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including human interaction with Earth.

- 5.6.1: Analyze the formation of soil, such as through weathering and erosion, the transport of soil by rain through streams and rivers, and the deposition of sediments in valleys, riverbeds, and lakes.
- 5.6.2: Analyze the impacts of the ocean and climate on Earth's surface features
- 5.6.3: Analyze the relationship between human activity, the climate, and Earth's non-living systems.
- 5.6.4: Investigate the strategies that could reduce the impacts of natural hazards and adapt to climate.

### **LIFE SCIENCE**

Standard 7: Students examine organisms' structures and functions for life processes, including growth and reproduction.

- 5.7.1: Explore how plants and animals have certain structures and behaviors that enable them to respond to changes in the environment and meet their basic needs
- 5.7.2: Examine how animals use sunlight indirectly through feeding on plants and/or other animals

Standard 8: Students inquire how organisms and populations of organisms obtain resources from their environment.

- 5.8.1: Describe types of interactions among organisms
- 5.8.2: Analyze how ecosystems change over extended time periods

Standard 9: Students explore how biological evolution explains unity and diversity of species.

- 5.9.1: Analyze mechanisms underlying the resemblance of organisms to one another
- 5.9.2: Recognize that fossils provide evidence that many plant and animal species are

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extinct and that other species have changed over time

- 5.9.3: Defend the value of maintaining biodiversity on Earth

### **Mathematics**

#### **Standards and Benchmarks**

#### DATA ANALYSIS, STATISTICS, AND PROBABILITY

Standard 7: Students demonstrate statistical thinking and apply statistical methods to collect, organize, analyze, display, and make inferences based on data.

- 5.7.1: Collect, organize, read, and display a data set of measurements in charts, graphs, and tables

Standard 8: Students use concepts of chance and probability to explain outcomes of real-life situations.

- 5.8.1: Conduct simple experiments where probabilities of all outcomes are equal

#### MEASUREMENT, GEOMETRY, AND SPATIAL SENSE

Standard 5: Students explore properties, relationships, and transformations of shapes and space using coordinate geometry and other representational systems.

- 5.5.1: Draw and identify lines and angles, and classify shapes by properties of their lines and angles
- 5.6.1: Convert like measurement units within a given measurement system
- 5.6.3: Relate volume to the operations of multiplication and addition, and solve real-world and mathematical problems involving volume.

## **Social Studies**

### **Standards and Benchmarks**

#### **HISTORY, TIME, CONTINUITY AND CHANGE**

Standard 1: Students reconstruct, interpret, and critique the causes and consequences of past events in the context of the institutions, values, and beliefs of the periods in which they took place.

- 5.1.2: Analyze how the beliefs and education of the society in which a person resides shape his/her “point of View”

Standard 2: Students investigate historical experiences of American Samoa, Oceania, the U.S., and the world to reveal patterns of continuity and change

- 5.2.1: Describe past communities in the context of the time period they existed without imposing present norms and values on historical events.

Standard 3: Students cite evidence that cultures are dynamic and change over time.

- 5.3.1: Draw conclusions about how culture changes in response to changing needs, concerns, social, political, and geographic conditions multiple geographic representations and tools (maps, globes, geospatial technologies).

#### **GEOGRAPHY, PEOPLE, PLACES AND ENVIRONMENT**

Standard 4: Students research and report on where people and places are located and why, utilizing imposing present norms and values on historical events

- 5.4.1 Use geographic tools (e.g., historical maps, elevation, relief maps, and map scales) to further understand a significant event or issue in U.S. history.

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Standard 5: Students draw conclusions about changes in the relationship between people, places, and environments.

- 5.5.1 Explain how colonization, westward expansion, immigration, and advances in transportation and communication changed geographic and demographic patterns in the U.S.

### **English Language Arts**

#### **Standards and Benchmarks**

#### WRITING

Standard 4: Students apply their knowledge of text types and purposes.

- 5.4.2: Explain events, procedures, ideas, or concepts from a historical, scientific, or technical text, and write about the information based on the text and other research

Sample Performance

#### SPEAKING AND LISTENING

Standard 7: Students present their knowledge and ideas orally and comprehensibly.

- 5.7.1 Plan and develop informational presentations, and cite resources

#### LANGUAGE

Standard 9: Students apply strategies to comprehend and utilize vocabulary appropriately in a variety of contexts: social, instructional, and academic.

- 5.9.3 Apply word knowledge when producing oral and written texts

### **Student Learning Outcomes**

#### **Water Quality**

- Students will be able to explain the importance of a healthy stream.
- Students will be able to use the pH scale in testing water samples.

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- Students will be able to understand the definition of Acid and Base.

### **Stream Water Plants**

- Students list the basic functions and parts of plants.
- Students will be able to identify the key features of invasive plants.
- Students will discuss the benefits of native plants including their habitat value for streams.
- Students describe how native plants contribute to water quality.

### **Stream Water Animals**

- Students will explain the importance of streams.
- Students will classify stream species according to their characteristics.
- Students will create a food chain of the local stream animals.
- Students will build a model of a local stream animal.

### **Population Growth**

- Students know the term population and understand that they are part of school population.
- Students identify that population changes over time and describe how Pago Pago population growth has changed the landscape.
- Students demonstrate in class experiment on erosion.

### **Pollution and its Sources**

- Students will learn of different sources of pollution that affects the health of streams
- Students will learn of the process of each source of pollution, their pollutants, and their contribution to the health of streams.

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- Students will learn to collect data, analyzed and graph into statistical reports

### **Stream Filtration and Mangrove Restoration**

- Compare and contrast the past and present of the Pago Pago Harbor.
- Students will learn the importance of mangroves to the ecosystem.
- Students will learn the process of mangroves filtration of the streams before it goes into the ocean.
- Students will learn to compare a healthy and unhealthy mangrove swamp.

### **Place-Based Lessons**

#### **Water Quality**

##### **Daily Lessons**

##### Lesson 1

##### I. Lesson Overview/Prior Knowledge

A. Start the class discussion by asking a question.

1. What is a healthy stream?
2. Clarify the meaning of two keywords explicitly.
  - a) healthy
  - b) Stream

##### II. Focus Event:

A. Prepare a short presentation or video explaining the effects of acid (Coke soda) on a rusted nail.

B. Discuss with the class what is taking place.

##### III. Materials:

A. Coke soda, rusted nail, beaker, timer(clock)

##### IV. Demonstration

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### A. Beginning Activity:

1. Discuss the topic, what is a healthy stream?
2. Relate the acid effects to living organisms in the streams.

### B. Middle Activity:

1. Share with the class their thoughts on what or why we need a healthy stream.
2. Use a web to brainstorm the effects, impact of an acidic stream

### C. Ending Activity:

1. Have the class pair-up in groups of 3 or 4
2. Locate or identify a stream near their home or village.
3. Draw a map of this stream.

## V. Closure:

- A. Have the class present the drawing of their stream in front of the class.
- B. Where is the location of this stream and does it have a name.
- C. Assessment (Text to Self) sense of ownership
- D. Write a paragraph explaining why we need a healthy stream.

## Lesson 2

### I. Lesson Overview/Prior Knowledge

- A. Briefly discuss why we need a healthy stream
- B. Lead the class discussion on the need to test the water in the stream.

### II. Focusing Event:

- A. Prepare a short presentation or video explaining the testing of water in the stream if it is acidic or alkaline.

III. Materials:

A. Chart: Key vocabulary words and definitions

1. pH scale chart 0-14
2. Frayer Model (graphic organizer)

IV. Demonstration

A. Beginning Activity:

1. Show the key vocabulary words and their definitions on the board.
  - a) Acid (acidic): is **water** with a potential hydrogen (pH) of less than 7.
  - b) Base (alkaline): pH of greater than 7 indicates a base.
  - c) Neutral : **Water** that has a pH of 7.
  - d) pH scale: measures how acidic or basic a substance is,
  - e) **buffer** solution; is one which resists changes in **pH** when small quantities of an acid or an alkali are added to it
2. Elaborate on the definition of each word, provide examples, non-examples, or a Samoan translation.
  - a) Display the pH scale and examples of related household products or goods to each unit.

B. Middle Activity:

1. Ask students to fill out the Frayer Model Graphic Organizer for each vocabulary word.

C. Ending Activity:

1. Have the class pair-up in groups of 2 or 3

2. Discuss/share their Frayer Model ideas.

V. Closure:

A. Choose four or more volunteers to share their Frayer-model in front of the class.

VI. Assessment (Text to Text) comparing text (Frayer model), rigorous learning

Write 3 to 5 questions about the vocabularies on the board (ticket out)

A. H/W Tell students to write a K.W.L. chart about the pH scale.

Lesson 3

I. Lesson Overview/Prior Knowledge

A. What is

1. Acid (Acidic)
2. Base (Alkaline)
3. Neutral
4. pH scale

II. Focusing Event: Testing of water samples

III. Materials:

- A. gloves, goggles
- B. pH scale chart and kit, litmus paper strips
- C. orange juice, lemon juice, baking soda, milk of magnesia, water

IV. Demonstration

A. Beginning Activity:

1. Introduce the Guest Speaker for the day. Hydrologist Matt Erickson.

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2. Mr. Erickson will be discussing the
  - a) pH scale and examples
  - b) the testing process or procedures
  - c) the environmental impact.

### B. Middle Activity:

1. Students will demonstrate the testing of water
2. Discuss what they see under a microscope (zoomie)

### C. Ending Activity:

1. Have the class pair-up in groups of 2 or 3
2. Compare and share testing results

## V. Closure

- A. Have students look at their K.W.L chart. Add any new information or learning or questions about the pH scale.

## VI. Assessment (Text to Text) comparing text, rigorous learning

- A. Write three new knowledge you've learned today.
- B. Note: ask each group to get empty plastic bottle, sport shoes.

## Lesson 4

### I. Lesson Overview/Prior knowledge

- A. What is
  1. Acid (acidic), Base (alkaline), Neutral, pH scale

### II. Materials:

- A. plastic bottles
- B. graduate cylinder

C. Notebook

III. Demonstration

A. Beginning Activity:

1. Make sure students have all of the necessary supplies and gear (e.g. sports shoes, empty bottle)
2. Students know their group members and responsibilities
3. Recorder, resource person. Handy person 1, Handy person

B. Middle Activity:

1. Students will be collecting water samples from at least three sites.
2. Students will be writing a short paragraph and or picture of the stream site.

C. Ending Activity:

1. Students will bring back this water samples from these three sites and test them for acidic or alkaline level.

IV. Closure:

- A. Each group will discuss their findings in front of the class. Comparing the three selected sites.

V. Assessment (Text to World) analyzing the information. Real world application

A. Post three to five questions

1. Which site is more acidic? Alkaline?
2. Who or what are the main causes (opinion) to this problem?

B. Homework:

1. Interview an older resident of your village.

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2. What was this stream like when they were young.
3. What changes did they notice or have seen along the years.

### Lesson 5

#### I. Lesson Overview/Prior Knowledge

- A. According to your interview, What changes to the streams have occurred over the years.

#### II. Materials:

- A. all notes from day one

#### III. Demonstration

##### A. Beginning Activity:

1. Discuss with the students their findings
2. What were the big changes to the streams?

##### B. Middle Activity:

1. Have students discuss in groups what are some possible solutions to this problem.
2. Have students suggest as a responsible citizen, what can they do.

##### C. Ending Activity:

1. Students will go back to the streams and collect trash.
2. Students will then sort all the trash (plastics, glass, metals, papers. Etc...
3. Students will then discuss, review, assume, what they will do with this information.

#### IV. Closure

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- A. Have students write a letter to the editor of Samoa News. A one or two paragraph essay about their concern on the health of our streams.
- V. Assessment (Text to World) sharing your information with the community.
  - A. Write a Letter: posted on Letter to the editor.

### **Additional Lessons - Water Quality**

STEM LESSON (Science) A change of one unit on the pH scale represents a change in the concentration of hydrogen ions by a factor of 10, a change in two units represents a change in the concentration of hydrogen ions by a factor of 100.

### **Stream Water Plants**

#### **Daily Lessons**

##### Lesson 1

- I. Prior Knowledge on Plant Names
  - A. Plant Names that grows in American Samoa (Think, Pair, Share)
  - B. Mapping
    - 1. Streams close to their homes with pictures of any plants that grow on or near them

##### Lesson 2

- I. **Plant parts and Functions** (Class Discussion)
- II. Key Words:
  - A. photosynthesis
  - B. environment, fibrous root
  - C. Chlorophyll
  - D. plant cycle

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## III. Types of Plants

## IV. Parts of Plants

## V. Engineering Connection

## VI. Assessments

### A. Pre-Assessment

1. Write a paragraph in their science journal logs describing what students know about plants and how they help keep us in good health.

### B. Post Instruction Assessment

1. Have students diagram the parts of a plant and label their functions, both above and belowground.

## VII. Question and Answer

A. What are the three types of plants (Possible answer: Herbs, shrubs and trees)

B. What is the process by which plants make their food? (Photosynthesis)

C. What is the part of the plant helps the plant to breath? (Leaves and leaf pores, stomata.)

D. What do you call the process I which plants release water (moisture) back into the atmosphere? (Transpiration)

## Lesson 3

### I. Native and Invasive Plants

### II. Key Words

A. Native

B. Introduced

- C. Invasive
- D. Habitat

**III. Guest Speaker:**

- A. Mr. Togia Tavita from National Park /ppt presentation on native plants and invasive plants (request for ppt he presented during course (Togia, 2018)
- B. Allow students to ask questions
- C. Work in groups
  - 1. Select a Stream Plant from the list presented by Mr. Togia research from their parents or grandparents and have the complete worksheet
- D. Brochure
  - 1. Take photos of Native Plants; glue on cardstock with three benefits on why each plant important to the environment.

**Lesson 4**

- I. How native plants contribute to the health of stream
  - A. Remind students that both humans and species in streams breathe oxygen. Explain that cool water can hold more oxygen than warm water.
  - B. If stream is too warm, living organisms in water will be unable to survive the low oxygen conditions.
- II. Nature Walk
  - A. Compare Several areas of stream by the school.
  - B. Have students record on their journal logs any animals they observe in streams under shade and streams with no shades

III. Acrostic Poem

- A. Have students write an acrostic poem that summarizes what they learned using concepts they learned including the role of plants in preventing erosion and maintaining water quality for animals in streams. (May use any key word or words from lessons.

**Stream Water Animals**

**Daily Lessons**

Lesson 1

- I. Map of stream, Importance of local streams
- II. Keywords:
- A. Stream
  - B. Aquatic
  - C. Vertebrate
  - D. Invertebrates
- III. Activity #1: Mapping a stream
- A. Materials Needed: construction papers, drawing supplies
  - B. ‘Where in the world is our stream?’
  - C. Think Pair Share Activity
    - 1. Is there a stream in your neighborhood/school?
    - 2. Have you visited a stream before?
    - 3. What does it look like?
    - 4. What lives in the stream?
- IV. Mapping

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- A. Show students a google map of the village of Pago Pago. Point out the streams in the village and the school.
  - B. Students that live close to each other will work together to map out their stream. Map should show a location to get there from school.
  - C. Include the animals that they see in the streams.
  - D. Share the maps with the class.
- V. Activity #2: Importance of local streams
- A. Significance of local streams
    - 1. Discuss with students the importance of our streams.
    - 2. Writing Activity #1
      - a) Have them list down what they think and post it on the board. Discuss the answers.
    - 3. Post this on the board and have everyone read:
      - a) Provide habitats and food for aquatic animals.
      - b) Streams also play a critical role in maintaining the quality and supply of our drinking water, ensure a continual flow of water to surface waters, and help recharge underground aquifers. (American Samoa Community College, Community and Natural Resources, 2009)
      - c) They protect against floods.
      - d) They drain the landscape, move water and minerals toward the ocean.

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4. Using the post above, students work in groups to illustrate what each important detail looks like.
5. Share with the class

### VI. Assessment

- A. Write a paragraph to explain what you now know about streams/Use the first writing activity to compare to the four significances already discussed.
- B. Writing #2: *Explain why streams are vital to our community.*

### VII. H/W

- A. Observe a stream near your house and write down what you see.
- B. Interview an older person about animals in the streams.

### Lesson 2 (Part 1)

- I. Aquatic stream organisms
- II. Keywords:
  - A. vertebrates
  - B. invertebrates
  - C. invasive species
  - D. decomposer
  - E. consumer
  - F. producer
  - G. food chain
- III. Activity #1: Vertebrates and Invertebrates

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### A. Classify stream animals

1. Divide into groups and distribute individual photos of local stream animals. Have them decide how to classify them into groups.
2. Share with the class/ Inform the class that they will reclassify the photos after the next activity

### B. Introduce local stream animals

1. Show a poster of the four groups of local stream animals
2. Fish, shrimps, snails, and insects

### C. Discuss the importance of each group:

1. Snails keep algae growth under control.
2. Shrimps filter organic debris from flowing water and hunt insect larvae hiding in sand and among small stones. They are also an important food source for fishes, birds, and—long ago—early settlers.
3. Fishes are an important food for large birds, and some people enjoy catching them for food and sport.
4. Insects are also food for fishes, some like dragonfly larva catch fish.

## IV. Reclassify the photos into 4 groups

- A. Write down the differences in each group
- B. Share with the class

## V. Classify stream animals into vertebrates and invertebrate

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- A. Inform students that fish, shrimp and snails all have gills and cold-blooded
- B. Introduce vertebrates and explain its meaning. (Animals with backbone)
- C. Introduce invertebrates and explain its meaning. (Animals without backbone)
- D. Students classify the four groups of animals into two groups: vertebrates and invertebrates
- E. Share with the class

### VI. Assessment:

- A. Students choose a stream animal and describe it using these components
  - 1. group
  - 2. importance
  - 3. vertebrate
  - 4. invertebrate

### Lesson 3 Aquatic Stream Organisms (Part 2)

#### I. ACTIVITY #1: Invasive Species in local streams

- A. What is invasive species?
  - 1. Students find the meaning of the word invasive (invade) and species (scientific name of living thing) to determine the definition/ Discuss
  - 2. Write the definition on the board: Invasive species is a species that is not native to an area and it can likely cause great harm to it.

3. Show a video of Invasive Species/ Discuss with students afterwards: “Do we have invasive species in our local streams?”
4. Inform students that mosquito fish and cane frogs (lage) are invasive species because they were brought in to control insects but they eat other animals and plants in the streams.
5. Invasive species role play: Students act out the play to identify the problem caused by an invasive specie to an ecosystem
6. In groups, have them draw two streams: one with invasive species and the other with no invasive species. How would it look like?
7. Share with the class

II. ACTIVITY #2: Herbivores, Carnivores, and Omnivores

- A. Introduce herbivores, carnivores, and omnivores and give examples
- B. Have students work in groups to create their own examples for each group.
  1. -Share with the class
- C. Teacher shares this passage with the class:
  1. Eddie the eel, Suka the shrimp, Sammy the snail, and Ina the insect walked into the restaurant and ordered food. Eddie wanted fish burger and a green salad, Suka picked a small fish and a green salad, Sammy decided on a small weed salad, and Ina selected both a tadpole sandwich and a weed salad.
- D. From the passage above, determine which group that fish, shrimp, snail, and insect fall into- herbivores, carnivores, and omnivores.

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### III. Activity III. Food Chain

A. Discuss food chain- teacher give examples

B. Students work in partners to create a food chain- use only one local stream animal for each part of the chain.

### IV. Assessment: Students will be given a graphic organizer to complete.

A. H/W Complete in-class projects if haven't finished

## LESSON 4: STREAM EXPLORATION

### I. Materials: data sheet

### II. Activity #1: Stream Tour

A. Students will walk to the stream near the school and observe the animals in it.

B. Record down what they see in the streams.

C. Record the number of organisms that they see.

### III. Activity #2: Sharing and discussion on the stream tour

A. Each group will report on the animals they identified in the stream and its total number.

B. Essential Question: What does this data show us about the health of the stream?

### IV. Activity #3: Create a bar graph

A. Teacher provides the example of her own data and how to put it into the bar graph.

B. Have students work in groups to create a bar graph of their data.

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C. Share with the class.

### V. ASSESSMENT

A. Write a paragraph to answer the essential question.

#### Lesson 5: Who Am I?

I. Materials: craft supplies, construction papers

II. Activity #1: Create your own local stream animal

A. Students will create a model of a stream animal using materials provided.

B. Each model will have a description of the group it belongs to, its importance, an vertebrate or invertebrate, and whether it is a herbivore, carnivore or omnivore.

C. Share with the class.

III. Assessment: Rubric will be used to assess the students

## Population Growth

### Daily Lessons

#### Lesson 1: Population Definition

I. Keywords:

A. Population,

B. community,

C. organism,

D. data collecting

II. Activity 1: Population

A. Introduction to Population (Snider, S. & Brimlow, J.N. 2013)

1. Use pictures to show population of different living things.

B. Definition of key concepts. (Drollinger, 2011)

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1. Population is the group of the same organism living in the same area.
2. Organism: Living things
3. Community: group of population of two or more organism living in the same area.

### C. Collecting data

1. Class population
2. Students work in groups to collect information from each grade level to find the population of the school.
  - a) Total number of students in each grade level.
  - b) Total numbers of boys and girls.

### III. Assessment

- A. Class presentation: Group share on the information they collected.
- B. Class discussion: Compiling of data collected
- C. Application: Class quilt to show

### IV. Homework: Look around your house and identify population of organism.

### Lesson 2: Population change over time.

#### I. Keywords:

- A. Census
- B. data
- C. change
- D. increase
- E. decrease

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## II. Activity 1: Department of Commerce Statistical Division Presentation

### A. What is the Census?

1. Why is the Census important?

### B. Population Data of Pago Pago from 1920-2010

### C. Class Discussion on the data of Pago Pago population.

1. Teacher use online graphing website to show the line graph of population of Pago Pago.
2. Class discussion on the trends of the line graph: increase and decrease.
3. Why do we need to learn about population growth?

### D. Assessment

1. Students will answer questions about the presentation and the line graph.
2. Questions:
  - a) What is the Census?
  - b) Why is the Census important?
  - c) What is the title of our line graph?
  - d) What is a trend?
  - e) What is population growth?
  - f) Why is it important to learn about human population growth?

## III. Activity 2: Population Growth changes our environment

## IV. Mapping

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- A. Show students map of Pago Pago.
  - B. Teacher explains the boundaries of Pago Pago on the map.
  - C. Have students share in their groups what they see on the map.
  - D. Have students share with the class their observations.
- V. Population growth and change.
- A. Teacher shows pictures of Pago Pago in the past and now.
  - B. Have students compare them.
    - 1. First school building to the new school site.
      - a) Why did they relocate the school?
    - 2. Pago Pago Park landfill.
      - a) What happen to the organisms in the ocean?
  - C. Watch video of population growth and environment
    - 1. The Human Impact on Earth (Wave of Change, 2011)
    - 2. Have students share in groups about the video.
    - 3. Students share with the class, which affects they see happening around Pago Pago.
    - 4. Teacher makes a list on the board.
- VI. Assessment
- A. A. Students write a paragraph explaining how population growth affects the environment. Students can select one affect to write about.

### Lesson 3: Erosion affects the environment.

- I. Keywords: soil erosion, water erosion, wind erosion, and ice erosion.
- II. Materials, pans, soil, water, fan, ice, boards.

III. Activity 1: What is erosion?

A. Define erosion

1. Erosion is the wearing away of the land.

B. Show a video of erosion. Class discussion: What are types of erosions?

1. Types of Erosion (MadameGameplay, 2015)

a) Wind erosion

b) Water erosion.

c) Ice erosion (glaciers)

2. Students experiment on erosion. Students work in station.

a) Divide the class into groups of four students.

b) Students follow directions in each station to complete the experiments.

IV. Assessment

A. Students complete the experiment worksheet

Lesson 4

I. Activity 1: Erosion around the school.

II. Materials: notebook, pencil, camera

III. Nature walk:

A. Students will walk around the school campus to look at areas they will see erosion. We will take photos of the area.

B. Class discussion on what students observed.

1. What is happening in the area because of erosion?

2. What can we do to stop the erosion?

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C. Split the class into groups to talk about ways they can stop the erosion in the school areas.

1. Groups need to come up with two ways to prevent erosion.

IV. Assessment:

A. Students write about what they observed on school campus about erosion.

B. Homework: Students look for erosion around their home.

### Lesson 5

I. Activity 1: Land Grant Presentation on ways to prevent erosion on school campus and the streams around the school.

A. Have students ask questions.

B. Students will work in groups again to look at ways to prevent erosion on campus.

II. Class project: Put into action what we can do to prevent erosion with in our school with the help of Land Grant, school administrators, and parents.

A. Grow plants next to stream.

B. Make a rain garden on campus area.

## Pollution and its Sources

### Daily Lessons

#### Lesson 1: Introduction to Water Pollution and Data Analysis

I. Introduction to sources of pollution and data analysis.

A. Activity: Pick-me-up!

1. Students pick up a piece of paper from the floor. Each piece of paper contains a pollutant or a source of the pollutant

2. Match a pollutant with source and write one sentence of their connection.

## II. Definition

### A. Key terms

1. Pollution: the presence in or introduction into the environment of a substance or thing that has harmful or poisonous effects
2. Data: facts and statistics collected together for reference or analysis
3. Analysis: detailed examination of the elements or structure of something, typically as a basis for discussion or interpretation.

## III. Demonstration

### A. Introduce pollution and different sources

1. Natural Pollution: Soil/natural debris
2. Residential Pollution: Human Activities
3. Industrial Pollution: Factories and harmful products

### B. Introduce data analysis and its importance

1. Explain
  - a) Collecting data
    - (1) Tally tables
    - (2) Frequency table
  - b) Types of data display
    - (1) Stem and Leaf Plot
    - (2) Histogram

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(3) Box and Whiskers Plot

(4) Line graph

(5) Scatter Plot

(6) Bar graph

(7) Circle Graph

### IV. Activity

#### A. Pick me up (continued)

1. List all pollutants found on floor and categorized them into 3 sources of pollution. Natural, Residential and Industrial Pollution

### V. Assessment/Homework

#### A. Assessment

1. Create a 3 Column Chart of Pollution Source and write 5 pollutants for each category (different from activity)

## Lesson 2: Natural Pollution - Soil and Plant debris

### I. Identifying natural pollution and its effects on streams.

#### A. Activity: Turbidity on Stream Video (Youtube Video)

### II. Definition

#### A. Key terms

1. Natural pollution, sediments, erosion, turbidity

### III. Demonstration

#### A. Identify

1. 3 types of common natural pollution
  - a) Soil and plants debris
  - b) Vegetables
  - c) Animals

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2. Explain soil factors that affect streams
  - a) Erosion as factor of stream pollution
    - (1) Developed lands and natural disasters
  - b) Environmental debris: plants, branches, leaves, tree trunks...etc.,
    - (1) Land development and agricultural

### B. Activity: Nature Walk - In groups of 4

1. Students task
  - a) List what types of natural pollutants you find in the area.
  - b) Sort list into the factors discussed in the lesson.
  - c) Explain how these pollutants occurred?

## VI. Assessment/Homework

### A. Group presentation on Nature Walk

### B. Homework

1. Observe and take pictures of pollutants found in streams.

## Lesson 3: Natural Pollution - Vegetables

### I. Identify vegetable pollution and its effects.

#### A. Activity: KWL

1. Write what you know about vegetables in the K column of the KWL chart.

### II. Materials

#### A. Laptops, projector

### III. Definition

#### A. Key terms

1. Vegetable pollution

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2. Metals, zinc, copper, nickel, cadmium
3. Nutrients

### IV. Demonstration

- A. Explain vegetable pollution.
- B. Explain the metals in vegetables and fruits and how it affects the health of streams.
- C. Filled in the W section of KWL Chart
- D. Activity: Research - In pairs
  1. Create a list of 5 vegetables and find what type of metal it contains.
  2. Presentation

### V. Assessment

- A. Complete KWL Chart
- B. Homework: Observe streams for vegetable pollution

## Lesson 4: Natural Pollution - Animals

- I. Identifying types of animal pollution and its effect on streams.
  - A. Activity: Metal Detecting River Danger: Pollution and Diseases Video  
(Youtube Video)
- II. Definition
  - A. Animal pollution
  - B. Fertilizer
  - C. Manure
  - D. Decompose
- III. Materials

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A. Laptop, projector, speaker

### IV. Demonstration

A. Explain animal pollution.

B. Explain factors of animal pollution and how it affect streams and stream animals.

C. Discuss the cycle of animal decomposition and how it affects the animals of the stream.

D. Activity: Nature Gallery

1. Collect natural pollution pollutants (solid resources or images)

### V. Assessment

A. Write a paragraph to summarize the 3 types of natural pollution.

## Lesson 5: Data Analysis - Stem and Leaf Plot

I. Analyzing natural pollution and create histogram to display data.

### II. Definition

A. Stem and leaf plot

B. Frequency table

C. Frequency

D. Histogram

### III. Materials

A. Chart paper, markers, laptop, projector/smartboard

### IV. Demonstration

A. Recall data analysis and explain key terms

B. Explain creating a stem and leaf plot and how to interpret data

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- C. Explain collecting data and creating a frequency table
- D. Using data from natural pollution, create a histogram and how to interpret histogram.
- E. Activity: Data Analysis Report
- F. Use natural pollution from previous lessons and analyze them.
- G. Create a frequency table, then create a histogram to display data collected.

### V. Assessment

- A. Data Analysis Report Presentation.

### **Additional Lessons - Pollution**

- Streams and Agricultural Pollution
- Streams and Residential Pollution (Human activities)
- Streams and Industrial Pollution
- Biodegradable and Non-Biodegradable Pollution

### Lesson Extensions

- Reduce, Reuse, Recycle: Envision waste and pollutants as resources
- Recycle Standard Classification

## **Stream Filtration and Mangrove Restoration**

### **Daily Lessons**

#### Lesson 1: Mapping of the Harbor

- I. Keywords:
  - A. harbor
  - B. present

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- C. past
- D. recall
- E. Create

## II. Activity 1: Mapping of the Pago Pago Harbor

### A. Divide Class in groups of 4

1. Get to know your group members and be able to say 1 thing about their group member.
2. Each student will create a map of where they live heading towards the school.
3. Combine their maps into 1 map to identify the area and include the Pago Pago Harbor.

### B. Show map from the past and present

1. Power point of the Pago Pago Harbor in the past and present.
2. Create a Venn Diagram to compare and contrast the Pago Pago Harbor from the Power Point.

### C. Interview Elders (Homework)

1. Interview parents, grandparents, uncles, aunties, chief, and who ever they can about the life of the Harbor in the past.
2. Geography features
3. Animals/Plants

## III. Activity 2: Plants and Animals around and in the harbor

### A. Identify the animals and plants

1. Each group will create their list from homework

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2. B. Use resources *Local Plants of American Samoa*
3. C. Use resources *Stream Fauna of American Samoa*

### B. Plant Mangrove

1. A. Benefits of the tree in the Harbor
2. B. What happened to mangroves in the harbor?
3. C. Plant cycle of the mangrove

### C. Video on Mangroves

1. How do mangroves trees work?
  - a) Students write notes
  - b) Importance of Mangroves

### D. Draw and label mangrove

## Lesson 2: My Mangroves (Adapted from Pacific Island Climate Education Partnership)

- I. Activity 1: Why are mangroves important to me?
- II. Key Words:
  - A. benefit
  - B. change
  - C. harm
  - D. mangrove
  - E. Impact
- III. Activity 1: Introduce Vocabulary
  - A. Using the vocabulary cards, show each word and give the definition. Post the words on a wall.

- B. Have the class draw pictures to each word and use the key vocabulary to create meaningful sentences related to the picture. Teacher can model first.

IV. Activity 2: Activate Prior Knowledge

- A. Read aloud the essential questions for this lesson.
- B. Give students some time to think about the questions. Ask for <sup>[ ]</sup><sub>[SEP]</sub>volunteers to share their thoughts.

V. Activity 3: Imaginary Walk

- A. Visit your favorite place in your mind -- Where is this place? Is it close to your house or school?
  1. Draw the trees – what do the leaves look like? What do the roots look like?
  2. Draw the water – is your favorite place near the ocean or near a river?
  3. Draw the animals – do you see clams? Crabs? Fish? Birds? Other animals?
  4. Draw people – How do people use this place? Do they go swimming here? Playing? Paddling in a canoe? Do they gather fish, clams, or crabs to eat? Do they cut down trees?
- B. What is your favorite activity to do in your favorite place in the mangroves?
  1. Example sentence frame: I like to \_\_\_\_\_ (from / in) the mangrove.
- C. Ask volunteer to share

VI. Activity 4: Watch a Video (Mangrove Elder Interview)

A. Stop after the first question and answer this on your drawing:

1. What are some of the ways that people use mangrove?
2. What are some of the ways people in the community use the mangrove?
3. How does the family benefit from mangroves?
4. Add additional features to your drawing (other trees, animals, people)

B. Stop after the second and third question and answer this on your drawing:

1. What are people doing that harms the mangroves?
2. What changes are these elders noticing in the mangroves?
3. Add more features to your drawing like before

C. After the last question, answer the following on your drawing.

1. What can you do to help protect the mangroves?

VII. Activity 5: Summarize the video

A. Use guided questions (below) to summarize work

1. Why are mangroves important to us?
2. What are people doing that is harming the mangroves?
3. What do you think we can do about it?

VIII. Closure

A. Gallery Walk

1. Students post drawings on a wall and view other students' posters.

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- I. Key Words: ecosystem, flooded, protect, habitat, sediment, coast
- II. Activity 1: Activate Prior Knowledge
  - A. Refer to Gallery Walk in lesson 2 and remind of the following questions
    1. Why are mangroves important to us?
    2. What are people doing that is harming the mangrove?
    3. What do you think we can do about it?
  - B. Read Aloud essential questions for this lesson. Give students some time to think about the questions. Ask for volunteers to share their thoughts.
  - C. Show pictures of different mangroves and complete the “K” (What we know) and “W” (What we want to know/questions) columns of K-W-: chart on mangroves.
- III. Activity 2: Introduce Key Words
  - A. Write each key word on a flash card, show each word, and give the definition using the “Frayer Model” and post on word wall.
  - B. Have the class draw pictures to each words and use the key vocabulary to create meaningful sentences related to the pictures (Teacher can model first).
- IV. Activity 3: Picture Walk
  - A. Identify title, author, and ask
- V. Activity 4: Questions for “Mangrove Swamp”
  - A. Answer the following questions
    1. Point to the map and ask: Where do mangroves grow?  
(“Mangroves grow between \_\_\_\_\_.”)

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2. Point to the right and ask: What can we find in mangrove swamp?  
("We can find \_\_\_\_\_ in mangrove swamp")
  3. What mangroves do? ("Mangroves protect the land and animals.  
Mangrove swamp is a habitat for \_\_\_\_\_.")
- B. Have students add to their Gallery Walk posters to reflect new learning from "Mangrove Swamp"
- C. Observe students and ask volunteers to share responses as "temperature check"
- VI. Activity 4: Discuss the relationship between a mangrove swamp.
- A. Where do mangroves grow? (Mangroves are located (at/near) \_\_\_\_\_ . The mangroves grow between \_\_\_\_\_.)
  - B. How is the mangrove swamp connected to other ecosystems? Refer to the river, seagrass bed, and reef. (water)
  - C. Where does the water come from?
  - D. Where does the water flow?
- VII. Activity 5: Create a model and demonstrate the water flow in and out of mangrove
- A. Use modeling clay or mud to build "land" with slope, a tray of salty water with sand that connects to "land". Use clay or small rocks to build a "reef" in the salty water, and create a seagrass bed in the salty water using sand and grass.
  - B. Use fresh water and create a "river" going downhill from the top of the slope.

C. Ask students

1. What happens to the area where the fresh and salty water meets (brackish water)?
2. What happens when we throw things into water from top of slope?
3. What happens when soil falls into the water at the top of the slope?  
(It goes downhill along the river, and becomes sediment.)
4. Where would the soil go if the mangrove swamp was not there?
5. How are the mangrove swamp, seagrass bed, and coral reef connected?

VIII. Closure

- A. Revisit K-W-L Chart and record new learnings.

Lesson 4: Presentation Day

I. Activity 1: American Samoa National Parks

A. Presentation from Tavita Togia

B. 2 Local Species of mangroves

1. Bruguiera Gymnorhiza (Oriental Mangrove)
2. Rhizophora Mangle (Red Mangrove)

Lesson 5: Mangroves in our community

I. Key words: hypothesis, names of plants and animals, observe, female, male, descriptive words for describe physical characteristics, measure, height, inch, foot, food web, turbidity, texture

II. Activity 1: Mangroves in the community

A. Activate Prior Knowledge

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1. Read aloud the essential questions for this lesson
2. Give students some time to think about the questions. Ask for volunteers to share their thoughts.
3. Read aloud a local story about animals found in mangroves. Ask students why did people create a story about animals?
4. Explain they will be making scientific observations and measurements at mangrove swamp

### III. Activity 2: Building background

- A. Introduce the words “observe,” “measure,” and “height” and explain meaning.
- B. Show pictures of different animals found in mangroves, and come up with descriptive words to describe observations of these animals. Record words.
- C. Ask students what are some ways to measure height of the following objects: desk, door, a person
- D. Explain to students when we measure height, we can use different tools such as non-standard tools (mats, span of palm) and standard tools (rulers, measuring tape). Review the use of inch and foot as standard measuring units.
- E. Teach meaning of the words “turbidity” (cloudiness, haziness) and “texture” (feel, appearance, consistency)

### IV. Activity 3: Purpose

- A. To observe and measure mangrove trees and common animals.

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- B. Students create a lab notebook for them to take
- C. Ask students what their predictions/hypothesis are to those questions.

Record their hypothesis

- D. Review observation and measurement template

### V. Activity 4: A day at the mangrove swamp

- A. At the starting point, pair up students and give each pair ruler and science log book.

- B. Gather all the students together and go over how to collect data:

1. Count the number and observe physical characteristics of mangrove trees, measure their height, observe animals, and observe animals and observe non-living characteristics (height of water, turbidity of water, and soil texture).
2. Students will work in pairs and observe and take down measurements along their line transects. Monitor and provide support.
3. Gather students and observe the surroundings

### VI. Activity 5: Sharing of observation

- A. Students review hypothesis
- B. In groups, compare observations using science log books.
- C. Discuss the different types of animals benefiting from the mangrove
- D. Show picture of mangrove crab and ask if students saw them on the mangrove.

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- E. Discuss and compare observations made on height of water, turbidity, and soil texture.

### VII. Activity 6: Graphing Data

- A. Teacher will show students a sample of a line graph and discuss the meaning of x-axis, y-axis.
- B. Select one type of data observed. (Use the number of trees in a quadrant)
  - 1. Label the graph
- C. Discuss the graph: what relationship does it show you? Does it show a pattern? What conclusion can you make about the type of mangrove trees in the mangrove swamp.
- D. Students will use the partner from the field trip share and describe a graph with rest of class.

### VIII. Activity 7: Report on visit to mangrove swamp

- A. Have students work with the same partners as their mangrove swamp visit
- B. Write a short report on their visit to the Mangrove Swamp:
  - 1. Summarize their observations and measurements
  - 2. Create a graph to show relationship between plants/animals and the quadrants along the line transect
  - 3. Include drawings from the observations
  - 4. Summarize learning from discussion in classroom

### IX. Closure

- A. Each group will present their report with the rest of the class.

## Lesson 6: Healthy Mangroves

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- I. Key Words: healthy, benefit, change, harm
- II. Activity 1: Key Words Review
  - A. Define the term healthy (physically strong, not likely to become ill or weak). Name characteristics of a healthy person, healthy animal, and healthy ocean
  - B. Review vocabulary
- III. Activity 2: Healthy Mangrove
  - A. If a mangrove environment/ecosystem is healthy, what will the mangrove ecosystem look like?
  - B. What kinds of living things will we find in the mangrove environment/ecosystem?
  - C. In small groups, create and label drawing of a healthy mangrove environment/ecosystem.
- IV. Activity 3: What can harm a healthy mangrove
  - A. Refer to lesson 3 and recall harms caused by people to mangroves
  - B. Listen to different scenarios of actions done towards a mangrove swamp
  - C. Create a cause/effect flow chart
    1. Show actions of humans
  - D. Compare students work
- V. Activity 4: Culminating
  - A. Healthy Mangrove song

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1. Students will work in small groups to create a song that describes a healthy mangrove and things to avoid that harm the healthy mangrove

### B. Outreach to other students

1. Students will put together drawings, pictures (from field trip), and work to create an iMovie to show other students of our school the importance of a Healthy Mangrove.
2. The iMovie will also include the songs written by the students

### **Conclusion**

This Unit Plan had discuss some critical issues pertaining to the vital conditions affecting the Pago Pago Harbor. These critical issues encompasses many areas from the rise in population to the deteriorating water quality, the decreasing of animal and plant species to the need to restore our natural habitats for our marine species. We believe that by educating our students about place based education and having them see for themselves the dire consequences of not doing anything about it, will give them a sense of belonging to a community and wanting to take care of it.

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Tables

POPULATION OF PAGO PAGO 1920 TO 2010

Year	Population	Annual Growth Rate (percent)
2010	3,656	-14.5
2000	4,278	21.6
1990	3,519	14.4
1980	3,075	25.5
1970	2,451	95.9
1960	1,251	-21.1
1950	1,586	69.8
1940	934	31.9
1930	708	24.6
1920	568	

Table 1. Population of Pago Pago from 1920 to 2010