MATHEMATICS AND NATIVE HAWAIIAN PLANTS

Included in this chapter:

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Part 1: Introduction and History

Educators are often challenged to find ways of engaging students in learning. Students can get bored very easily, and younger students may not absorb much information from just a lecture. Teachers want their students to enjoy the subject they are learning, so that students will want to learn and will pay attention. One way to engage them is to take the learning outside of the classroom -- especially for those students who often stare out of their classroom windows, wishing they were playing outdoors. How might teachers take mathematics lessons beyond four cement walls, so that students might be more joyful and engaged?

Many opportunities exist that can make concepts real and relevant to students by placing them in more realistic environments. When students are exposed to these types of learning contexts, their minds are freer to explore and be creative, regardless of the subject they are learning. Certain concepts can be particularly challenging for some students. Taking students outside may prevent frustration by making mathematical concepts relevant, since subjects are often easier to grasp when set in context. In an outdoor classroom, imaginations can run wild, so prepare to be amazed by the wonderful ideas students come up with as a result of being excited about learning.

Many mathematical concepts are present in nature and culture. In Hawaiʻi we are fortunate to be surrounded by vibrant tropical plants, many of which have long histories of use by Native Hawaiians. As masters at of horticulture, Native Hawaiians made good use of nature for a variety of purposes. They used kukui nuts to make candles, hala for baskets and cordage, naio, kī, pili,and lama in the construction of their houses, wauke and ʻākala to make kapa for clothing, and koa to make canoes and boards (Krauss, 1974). They also used plants to make musical instruments, in games and sports, for medicinal purposes, and for weaponry and caskets. Taking students outside and into nature's classroom enables them to learn about Hawaiian culture, mathematics, *and* history.

Part 2: Goal of Lesson Plan

Among the goals of this lesson is to have students become more aware of their natural surroundings. Some Hawaiian plants are especially unique because they cannot be found anywhere else on the planet. By incorporating mathematics, nature, and culture, teachers can help their students will develop a sense of appreciation for the environment in which they live.

As the students participate in the activities, they will become familiar with the common names and histories of some traditional Hawaiian plants. Students will ideally be able to identify some of these plants whenever they see them outside in nature. They will also learn how to observe number patterns, such as the Fibonacci sequence in a plant's flower petal count, leaf count, and seed head counts. As they their tabulate data, they practice using tables and recording observations. Students will also be observe symmetrical and asymmetrical patterns in Hawaiian plants as well as identifying geometric shapes in plants' physiological structures.

PUA MELIA
Frangipani
Plumeria Rubra

PALAPALAI
Native Hawaiian Fern
Microlepia Strigosa

Some of the standards and benchmarks addressed by this lesson include:

◊ Categorize and justify a number as being odd or even.

◊ Create and describe growing numerical and spatial patterns and generalize a rule for the pattern.

◊ Cultural Anthropology: Systems, Dynamics, and Inquiry – Understand culture as a system of beliefs, knowledge, and practices shared by a group and understand how cultural systems change over time.

Activities in this lesson address Common Core State Standards for Grade 4 Geometry (4.G.3.): Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry (Common Core State Standards Initiative, 2012).

Part 3: Methodology

In the first activity, the teacher engages the students by sharing moʻolelo (legends) with them that are associated with certain plants as well as these plants' traditional uses. The teacher will then have each student choose a specific plant on which to do a short mini-research project that he or she will share with the rest of the class. This activity will help students familiarize themselves with the plant names, history, and uses.

The second activity will allow students to explore the features of traditional Hawaiian plants by identifying geometric shapes observable within them. The students are given a worksheet with pictures of Hawaiian plants and are tasked to write down all of the geometric shapes they can identify within the picture. They will also quantify how many of each geometric shape they see within the flower, the fruit, the stems, and the leaves of the plant. This activity can also serve as an art project, where students use geometric-shaped sponges (and paint) to create their own plant print. The students could also compose a moʻolelo about one of the plants.

The next activity involves students observing number patterns in their natural surroundings. The students will participate in a field study at one of Hawaiʻi's many botanical gardens., which on some of the familiar gardens on Oʻahu include: Hoʻomaluhia Botanical Garden, Harold Lyon's Arboretum, Foster Botanical Garden, and Hawaiʻi's Plantation Garden. Students can work in groups of three or four to answer questions on their activity sheet. They will learn to identify the native (and non-native) Hawaiian plants and learn about quantifying and tabulating data by counting the number of leaves, number of flower petals, or seed heads on certain plants. See if they can find a pattern in the numbers they see in nature or relationship to the Fibonacci sequence: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, etc. For example, the number of flower petals on a Hibiscus is 5, a Fibonacci number. Have a discussion about why Fibonacci numbers are commonly found in nature and depicted in art.

Another activity could have students identifying symmetry in traditional Hawaiian plants. The teacher can choose several Hawaiian plants from which to generate an activity worksheet, where students have to draw each plant's line of symmetry. The teacher could also include some Hawaiian plants that are not as obviously symmetrical, such as the noni plant. An additional challenge would be to have the students draw the reflected half of such plants as if they were symmetrical.

Part 4: Conclusion

It is very important for students in Hawaiʻi to be aware of their natural environment. Some Hawaiian plants deserve special attention because of their uniqueness to Hawaiʻi and because they are constantly being threatened by invasive plant and animal species and human activities. Hopefully this lesson will encourage your students to want to learn more about Hawaiian plants: how they developed unique features, how they were used, and how they fit into our island ecologies. If students are knowledgeable about plants, then they may be more inclined to help protect those that are endangered and, perhaps, even help them become reinstated and preserved in nature. That way, these plants will be around for future generations living in Hawaiʻi to also learn about and enjoy.

References

Common Core State Standards Initiative. (2012). Retrieved July 5, 2012 from http://www.corestandards. org/Math/Content/4/G.

Krauss, B. H. (1974). *Ethnobotany of the Hawaiians.* Honolulu, HI: University of Hawaiʻi Press.

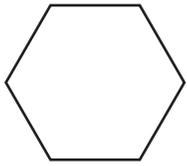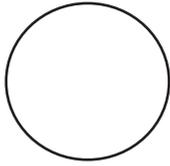# Worksheet 1

Geometric Shapes in Nature

Identify the geometric shapes you see in the various Hawaiian plants. How many of each geometric shape can you find in each of the plants?
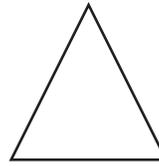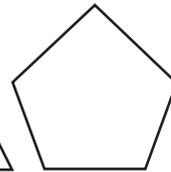

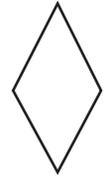| Hexagon | Circle | Square | Rectangle | Triangle | Pentagon | Diamond | Star |

PŌHUEHUE	
ALOALO	

'AWAPUHI 'ULA'ULA	
LOULU	
PALAPALAI	
HALA	

ʻŪLEI	
PUA MELIA	
KOKIʻO	

Worksheet 2

Name _____   Group # _____

Date _____

Botanical Garden Field Trip Activity: Number Patterns in Nature

Plant Name	Image of Plant	Flower Petals	Seed Heads	Leaves	Leaf Veins	Fruits	Misc.
PALAPALAI Native Hawaiian Fern Microlepia Strigosa							
HALA Screwpine Tree Padanus Tectorius							
KOKI'O Red Hibiscus Hibiscus Koki'o							
'ŌHI'A LEHUA Metrosideros Polymorpha							
LOULU Native Hawaiian Palm Pritchardia Hardyi							

Name _____   Group # _____

Date _____

Botanical Garden Field Trip Activity: Number Patterns in Nature

Plant Name	Image of Plant	Flower Petals	Seed Heads	Leaves	Leaf Veins	Fruits	Misc.
ʻAWAPUHI ʻULAʻULA Hawaiian Red Ginger Alpina Purpurata							
ALOALO Native Yellow Hibiscus Hibiscus Brackenridgei							
ʻŪLEI Hawaiian Rose Osteomeles Anthylidifolia							
LAUAʻE Maile-Scented Fern Phymatosorus Scolopendria							
KĪ Ti Leaf Cordyline Fruticosa							

Name _____ Group # _____

Date _____

Botanical Garden Field Trip Activity: Number Patterns in Nature

Plant Name	Image of Plant	Flower Petals	Seed Heads	Leaves	Leaf Veins	Fruits	Misc.
HELICONIA Lobster Claw Heliconia Caribaea							
LOʻI KALO Taro Colocasia Esculenta							
PUA MELIA Frangipani Plumeria Rubra							
NONI Beach Mulberry Morinda Citrifolia							