Many students have a great fear and anxiety of mathematics. In high school many students ask the teacher, “When are we ever going to use this?” These students are unaware that mathematics is everywhere and in our everyday lives. Simple and unnoticed daily actions can easily be described using mathematics; for example, if you don’t do your homework (x-value), then you will receive a poor grade (y-value). Ubiratan D’Ambrosio coined a term he called “Ethnomathematics”. This term may sound intimidating, but it is basically the study and relationships between mathematics and culture (D’Ambrosio, 2001).

Dr. Linda Furuto, mathematics professor at the University of Hawai‘i West O‘ahu, said, “Mathematics is not solely contained within the four sterile walls of the classroom but it is everywhere we look, everywhere we touch from the oceans to the mountains to the heavens.” This statement by Dr. Linda Furuto is true in many ways, students who have mathematics anxiety don’t even realize they are doing mathematics at times. Having the students engage in real-world situations, that are relevant to their culture and history will solidify the connection of mathematics to their life.

By incorporating mathematics and culture, this lesson plan will utilize Hawai‘i’s unique environment and native plant species. The purpose of this Ethnomathematics lesson plan is to engage students with our rich history and culture so they understand the basic concepts of geometric equations, and linear functions. The lesson will also focus on how invasive plant seeds may disperse and affect Hawai‘i’s native plants in the event of strong winds.

Hawai‘i has a very diverse cultural and natural aspect, which attracts many tourists who seek to relax in paradise and a warm year-round tropical climate for honeymoons, marriage, or leisure. Hawai‘i also lures many worldwide scientist and researchers because it houses the second most active volcano in the world, Kilauea, on the Big Island. Although Hawai‘i’s population is exponentially growing, we must remember that Hawai‘i was not always as urbanized as it is now.

About 3,000 years ago, the Polynesians began to explore the numerous tiny islands in the grand Pacific Ocean, and on their
exploration they came across the Hawaiian Islands. When they arrived, an abundant amount of marine food was available, however minimal edible plants/vegetation were available. Luckily, they brought along with them breadfruit, taro, bananas, and much more.

Did you know Hawai‘i is the most isolated landmass in the world? The closest landmass is California, which is about 2,390 miles away. Due to the isolation, Charles Darwin's theory of natural selection supports why Hawai‘i has many unique plants and animals. Over the century, there have been many accidental or introduced alien plant species that place a threat against Hawai‘i's native plants. A great example is Brachiaria mutica, also known as California Grass; this species of grass grows as high as 2 meters, which would easily outgrow many shrubs and trees (Smith, 1998).

Preserving Hawai‘i's natural environment is very important because our plants and animals are one of a kind. However, if winds can have an effect on the dispersal of invasive plant seeds, volunteers will need to work hard to save the native plants. We must preserve what we have now and save our endangered plant and animal species before it become a larger problem.

Part 2: Goal of Lesson Plan

The goal of this Ethnomathematics lesson plan is to provide students with mathematical knowledge and experience, to widen their perspective of how they can apply math to everyday life and ongoing trends. Students will also strengthen their skills in geometric equations, and linear functions.

This lesson plan satisfies multiple sections of the Common Core Mathematics Standards, for the seventh grade.

Grade 7: Common Core Mathematics Standards

1. 7.EE.1. Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

2. 7.EE.2. Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. For example, a + 0.05a = 1.05a means that “increase by 5%” is the same as “multiply by 1.05.”

3. 7.G.4. Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.

Part 3: Methodology

**BASIC MATH SKILLS COVERED:**

- Linear Functions
- Radius/Area of a Circle
- X/Y Table – Identifying Patterns
- Graphing

**MATERIALS/TOOLS:**

1. Worksheet
2. Paper
3. Pencil/Eraser
4. Calculator (optional)

**BACKGROUND OF THE PROBLEM/ SPECIFIC CONCEPTS:**

The ‘Akoko is a native and endangered plant that was discovered near the steep cliffs of the Nu‘uanu Pali, on the island of O‘ahu. A widely spread invasive plant found in Hawai‘i is the California Grass that is known to cover many forests and mountainsides. Hawai‘i has many invasive plants that can have damaging effects on our native plant species. With the use of a variety of different mathematical equations we can determine where to expect invasive plant seeds. This will give us a better idea where an influx of baby invasive plants may sprout.

**DETAILED DIRECTIONS:**

Step 1: Review problems with your students on linear functions, area of a circle, x/y tables, and graphing. Then go over the history of this lesson plan.

Step 2: Create a linear equation with the given information below. *See conclusion for alternative scientific activity

Assume 1 mile per hour (mph) winds can spread seeds up to 2 feet. Create a linear equation (ex. y = mx + b) to use with the following question. State what your variables are.
Student Answer(s):

\[ y = 2x + 0 \text{ or } y = 2x \]

Where: \( y = \) Radius in feet (ft)
\( x = \) Wind speed in miles per hour (mph)

Step 3: Students will find the radius with the equation they created; they will then calculate the area of the circle to answer the question in the problem below.

A group of student volunteers are planning a service learning project that is done monthly. Over the past month the wind speeds in Nu‘uanu were equal to or less than 20 mph. If the ‘Akoko is 50 feet away from the invasive plant (California Grass), should there be a concern of California Grass seeds near the base of the ‘Akoko?

![Diagram of wind and distance](image)

**CALCULATING THE RADIUS**

\[ Y = 2x + 0 \]
\[ Y = 2(20) + 0 \]
\[ Y = 40 + 0 \]
\[ Y = 40 \text{ ft} \]

**Calculating the Area**

\[ \text{Area} = \pi \times r^2 \]
\[ \text{Area} = \pi \times 40^2 \]
\[ \text{Area} \approx 5026.55 \text{ ft}^2 \]

**Student Answer(s):**

With 20 mph winds there shouldn’t be concern about the invasive plant seeds being blown to the base of the ‘Akoko.

**Student Reflection:**

1. Why is this information (radius/area) helpful for the prospective volunteer group?

**Possible response (Responses will vary):**

Finding the area around the invasive plants will allow the student group to determine the general area that will need to be cleared. Knowing this information is important because the volunteer group can use the area size to estimate the amount of workers they will need to clear the land.

**Step 5 Exercises**

**X/Y TABLE**

**Instructions:** Based on the question above, about what wind speed would the invasive plant seeds drift to the base of the ‘Akoko? Use the table to plot points and graph. Circle your answer on the table.

To answer this question the student should create a X/Y table. Example below:

<table>
<thead>
<tr>
<th>X (Wind Speed)</th>
<th>Y = 2x</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 mph</td>
<td>40 Feet</td>
</tr>
<tr>
<td>21 mph</td>
<td>42 Feet</td>
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<tr>
<td>22 mph</td>
<td>44 Feet</td>
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<tr>
<td>23 mph</td>
<td>46 Feet</td>
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<tr>
<td>24 mph</td>
<td>48 Feet</td>
</tr>
<tr>
<td>25 mph</td>
<td>50 Feet</td>
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</tbody>
</table>

The student should be able to distinguish the pattern.
Solution:

Based on the X/Y table we can conclude that 25 mph winds would show signs of the invasive plant seeds at the base of the Akoko.

GRAPHING

Question for Students:

1. What quadrants should you focus on Quadrant I, II, III, IV? Explain.

Responses will vary: Quadrant I. It is impossible to have a negative speed of wind, such as -1 mph.

Instructions: Using the points the students solved above, have them graph it. This graph will be used to reinforce their written response for the question above.

Example of the graph

![Graph Example]

Step 6: Concluding response questions

1. What other real-world applications can you use linear functions and geometric equations on?
2. Critical Thinking: In your own words describe what you think math is and why it is important?

Part 4: Conclusion

At the conclusion of this lesson plan students should have a stronger understanding about how they can relate their personal history, culture, and everyday world situations to linear functions, radius/area of a circle, x/y tables, and graphs. If you would like to take this lesson plan further great field trips/activities are listed below.

◊ Many organizations around Hawai’i arrange clean ups to restore and clear land for Native Hawaiian Plants. Not only will your students be actively engaged in math, they will be servicing their community.

◊ Alternative for “Step 2: Create a linear equation with the given information below”.

Instead of having the students use the given information to create a linear function, conduct a science lab. Please note that answers will be different if this option is taken.

Materials: Shreds of paper, tape measure, anemometer.

Steps:

1. Using the anemometer measure the wind speed in miles per hour (mph). Be sure the person measuring the wind speed does not move (they will be a reference point).
2. Throw the shreds of paper in the direction of the blowing wind.
3. Once the shreds of paper settle, measure the distance in feet (from the wind measurer to the closest paper shred).
4. Calculate how far the paper traveled for every mph of wind. Example: If the wind is measured at 15 mph and the nearest shred of paper is 13 feet, the paper traveled about 13 / 15 = .87 feet for every 1 mph of wind.
5. Use your information to create the linear function on how far the invasive seeds will travel, assuming that the shreds of paper resembled the seeds of the invasive plant.

** If an anemometer is unavailable you may use this resource: http://www.energyquest.ca.gov/projects/anemometer.html
The ʻAkoko is a native and endangered plant that was discovered near the steep cliffs of the Nuʻuanu Pali, on the island of Oʻahu. A widely spread invasive plant found in Hawaiʻi is the California Grass that is known to cover many forests and mountainsides. Hawaiʻi has many invasive plants that can cause damaging effects on our native plant species. Invasive plants can cause suffocations due to their overgrowth. With the use of a variety of different mathematical equations we can determine where to expect invasive plant seeds. This will give us a better idea where an influx of baby invasive plants may sprout.

**Problem:**
A group of student volunteers are planning a service learning project that is done monthly. Over the past month the wind speeds in Nuʻuanu were equal to or less than 20 mph. If the ʻAkoko is 50 feet away from the invasive plant (California Grass), should there be a concern of California Grass seeds near the base of the ʻAkoko?

1) **Use the given information below to create a linear equation which solves for y, when y = radius. State your variables.**
   Assume 1 mile per hour (mph) winds can spread seeds up to 2 feet. Create a linear equation (ex. \( y = mx + b \)) to use with the following question.

2) **Using your equation that you created. Find the radius for the circle below.**

3) **Using the answer that you found in question number 2. Find the area of the circle.**

4) **If the ʻAkoko is 50 feet away from the invasive plant (California Grass), should there be a concern of California Grass seeds near the base of the ʻAkoko?**
5) Why is this information (Radius/Area) helpful for the prospective volunteer group?

6) What wind speed would the invasive weed seed’s have drifted to the base of the ‘Akoko? Use the table to plot points, and graph. Circle the wind speed on your table.

<table>
<thead>
<tr>
<th>X (Wind Speed)</th>
<th>Y (Radius)</th>
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7) Using graph paper, graph the points that you calculated above. What quadrant should you focus on? (Circle answer)

   Quadrant I    Quadrant II    Quadrant III    Quadrant IV    None

Why?