Neʻepapa Ka Hana 2.0
Eighth-Grade Mathematics Resources
STEMD² Book Series

STUDENT ACTIVITIES

# LET'S GO FISHING

STEMD² Research & Development Group
University of Hawaiʻi at Mānoa

STEMD$^2$ Research & Development Group

Center on Disability Studies

College of Education

University of Hawai'i at Mānoa

http://stemd2.com/

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Neʻepapa Ka Hana Eighth-Grade Mathematics Resources

# Let's Go Fishing

*Student Activities*


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# Contents

# Preface

## About the STEMD$^2$ Book Series

The STEMD$^2$ Book Series for eighth-grade mathematics was developed as part of a technology-enabled pedagogical approach (Ne‘epapa Ka Hana model) for teaching mathematics in Hawai‘i middle schools. This book series seeks to provide Hawai‘i middle school teachers resources and training to incorporate problem-based learning, social learning and inclusive pedagogy through a culturally relevant mathematics curriculum. The series currently includes:

**Let's Build a Canoe** – Student Activities and Teacher's Guide (Common Core aligned)
**Let's Play the ‘Ukulele** – Student Activities and Teacher's Guide (Common Core aligned)
**Let's Go Fishing** – Student Activities and Teacher's Guide (SBAC aligned)
**Let's Make Da Kine / E Hana Kākou** – Student Mini Projects and Teacher's Guide in English and ‘Ōlelo Hawai‘i (Skill development)

The printed and online resources produced by NKH through STEMD$^2$ are fully aligned with the Common Core Standards for Mathematical Practice and Content and the Smarter Balanced Assessments for mathematics. Based on the on GO Math!® curriculum structure, the NKH STEMD$^2$ book series and social learning platform (`community.stemd2.com`) is flexible for teachers to implement partially or fully in their classrooms, as a tool to encourage students' interest and achievement in STEM subjects.

Funded by a three-year grant from the Department of Education's Native Hawaiian Education Act Program, Ne‘epapa Ka Hana is a project of the STEMD$^2$ Research & Development Group in the Center on Disability Studies at the University of Hawai‘i at Mānoa. More information about STEMD$^2$ is available online at `www.stemd2.com`.

# Unit 1: The Number System

**Activity 1.1**

Mauna Kea is about $1.38 \times 10^4$ feet tall. Yellowfin tuna, or better known as ahi in the islands, have been recorded to reach depths of $3.8 \times 10^3$ feet in the ocean. How much higher is Mauna Kea than the recorded depth an ahi can reach?

**Activity 1.2**

You and your friends have kept track of all the hours each of you went fishing for the past 5 years ($Y$), and how many fish each of you caught ($X$). Find out who has the highest ratio of *number of fish caught* to *number of hours spent fishing* by filling out the table and comparing their ratios. Keep in mind there are different types of fishing, some people scoop nehu (small bait fish) and count that too.

| | Number of fish caught ($X$) | Number of hours spent fishing ($Y$) | Ratio $\left(\frac{X}{Y}\right)$ |
|---|---|---|---|
| You | $3^4$ | $3^5$ | |
| Robert | $2^2$ | $2^{-2}$ | |
| Sara | 2 | $\left(\frac{1}{2}\right)^2$ | |
| Mike | $(-5)^4$ | $(-5)^6$ | |

Who had the highest ratio?

**Activity 1.3**

The area of the island of Oahu can be estimated by looking at its greatest dimensions, which is about $7 \times 10^7$ millimeters long and about $5 \times 10^7$ millimeters wide. If you wanted to make a square net with *enough area to cover the entire island*, how long should each side be? So if $d^2$ is the area of the island of Oahu, solve the following to determine the length $d$. Please round your answer to the nearest million millimeters, then write it in scientific notation.
Hint: Area of net = $d^2 = (7 \times 10^7)(5 \times 10^7)$.

**Activity 1.4**

The price for fresh poke on the island varies with the supply of fish available. Some of these fish are bought fresh from local fishermen. Unfortunately, today the market's scale was broken and can only weigh things in grams. The worker informs you that today's market price for ahi is $17.64 per kg ($1 \times 10^3$g $= 1$kg).

The following table shows a great day's catch (4 ahi) and how much you're offered to sell your fish to the market. Wanting to become a more experienced fisherman who sells fish to the market, you would like to calculate the ahi's weight for future reference. Does each fish weigh between $4.219 \times 10^4$ and $53.21 \times 10^3$ grams?

| Fish | Price of fish ($) | Weight of fish (grams) | Between $4.219 \times 10^4$ and $53.21 \times 10^3$? (Write *Yes* or *No*) |
|---|---|---|---|
| #1 | 800.00 | | |
| #2 | 920.20 | | |
| #3 | 760.00 | | |
| #4 | 640.00 | | |

# Unit 2: Proportional and Nonproportional Relationships and Functions

**Activity 2.1**

It is usually much safer to go fishing with your friends than by yourself. A lot of dangerous things can happen while out on the ocean, so it's good to have some friends around who can help. For example, a common rule for spearfishing is to have one diver underwater while their partner stays on the surface, waiting to help if needed. Fill out the two tables below. Both tables should show that more lives are saved when there are more people present. The first table should show a function between *people present* and *lives saved*, but the second table should not be a function.

**Function**

| People present (number) | Lives saved (number) |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |

VS.

**Not a Function**

| People present (number) | Lives saved (number) |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |

**Activity 2.2**

There's a graduation party coming up at the end of the summer, and you want to provide fish for your friends and family who attend. So you decide to go fishing for *oama* (juvenile goatfish) the week before the party. You plan to catch the bag limit of 50 oama per day to get to your goal of 200 oama for the party.

Here's a recap of how each fishing day went:

1. The oama weren't biting for half the day, but then the pace of your catch picked up nicely and consistently.

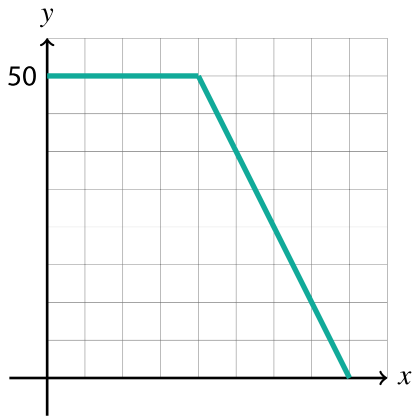
2. As soon as you got to your fishing spot, a nice fishermen gave you 50 oama because he had caught too many. Instead of taking it all home, you decided to use some for bait and fish for fun. At the end of the day, you got back to fishing for oama to replace the ones that you've used.

3. The oama was biting consistently throughout the day and you caught your limit for the day.

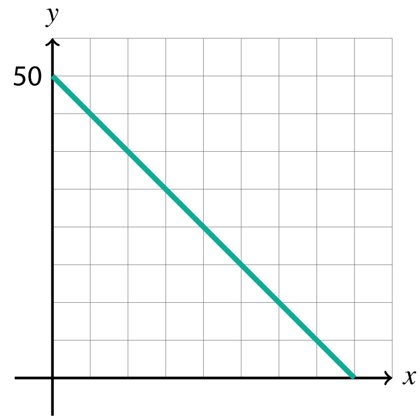
4. The oama were biting well and you caught 30 oama quickly, but then you gave some away to another fishermen. Later, you finished catching your limit.

Each of the following graphs represent the amount of oama you need catch for the day ($y$) vs time ($x$). Match each graph with a story from above (1-4).

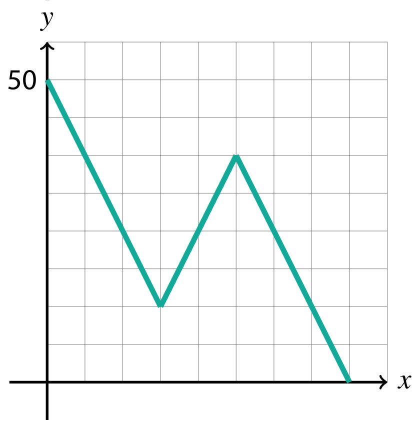
**Graph A**



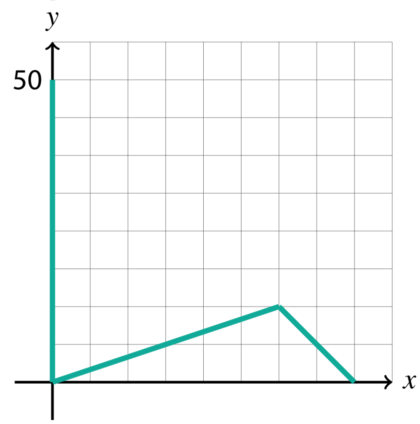

**Graph B**




**Graph C**

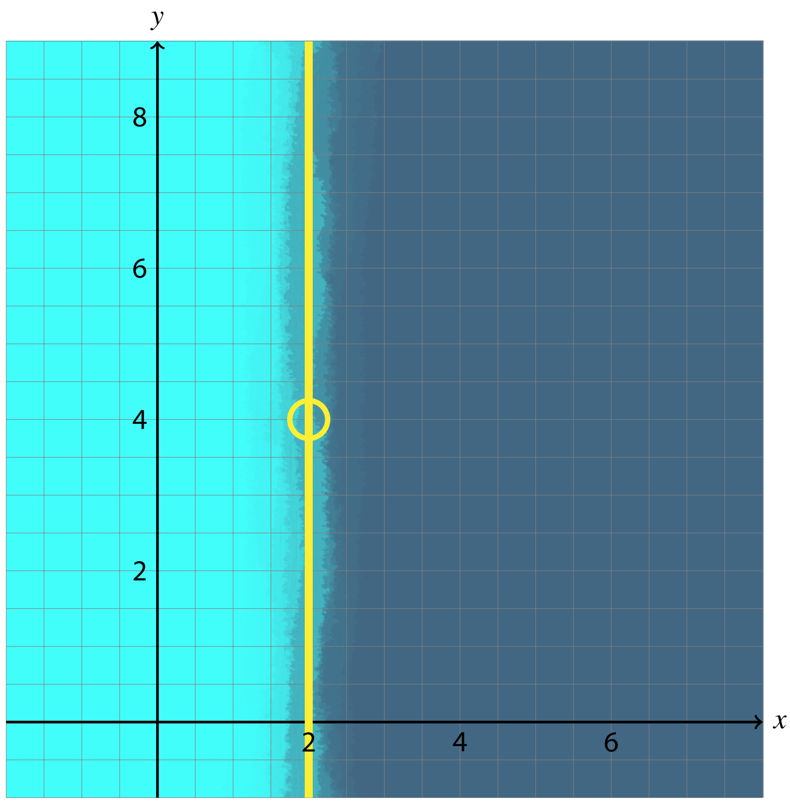



**Graph D**



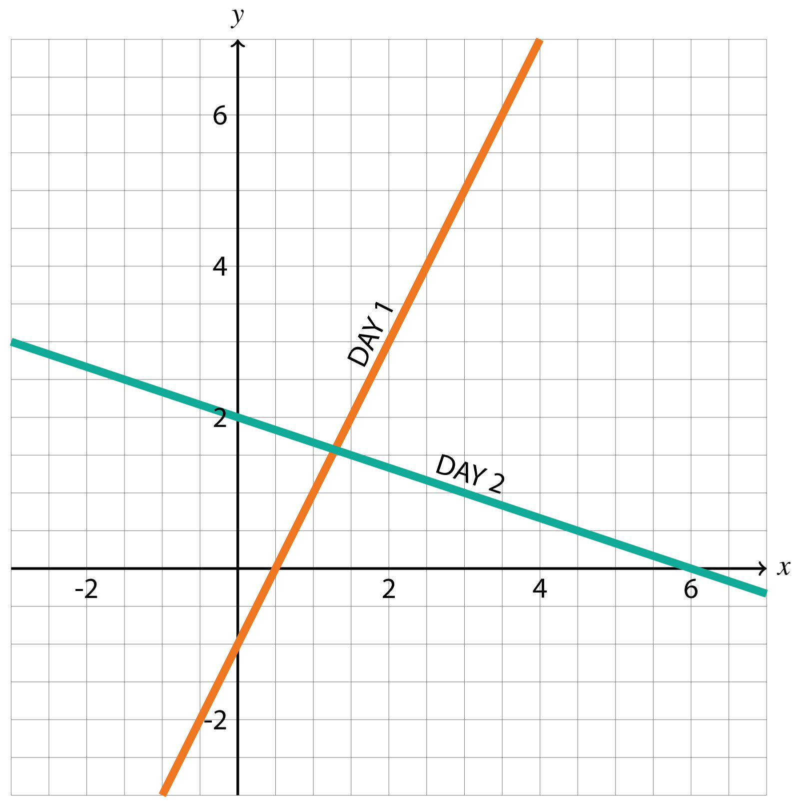
**Activity 2.3**

Finding fish can be hard at times, but there are places where fish tend to hang out. One of these places is along ledges and steep drop offs of the reef. Below is a bird's eye view of a reef with a line showing its drop off. The circle at (2, 4) is a good place to catch fish. What are three other coordinates that are good places to find fish?



**Activity 2.4**

A modern GPS (Global Positioning System) can accurately pinpoint your location and track your progress throughout a day. Below is the GPS data from your last two fishing trips.




Find the equations to best describe your path for the Day 1 (the orange line) and Day 2 (the blue line) to let your friends know where the fish was biting.

Are these equations examples of linear functions?

**Activity 2.5**

A *live well* is a container with a water pump used for keeping fish alive, typically fish that will be used as bait. Suppose that your live well is cylindrical with a height of 10 inches and a radius of 4 inches. Your water pump can bring in new salt water at a rate of 100 cubic inches per minute. At this rate, how long will it take you to completely fill your live well without it overflowing? Round your answer to the nearest minute.

**Activity 2.6**

Oama season has come again this summer, and here is how the day went fishing for you:

- For the first hour, the fish were biting fast, then it slowed down, You caught 10 oama.

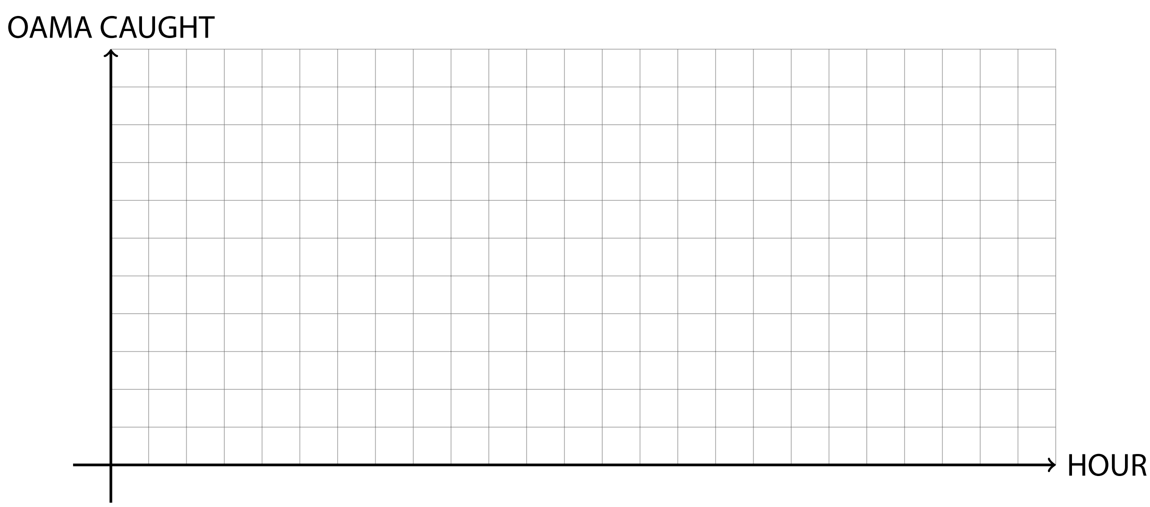
- Over the next two hours, the fish were biting at a steady rate until you had 25 oama total in your cooler.

- Unfortunately, for the next hour, the fish weren't biting at all.

- In the hour after that, the fish started biting slowly. Luckily, the fishing picked up, and you now 40 in the cooler.

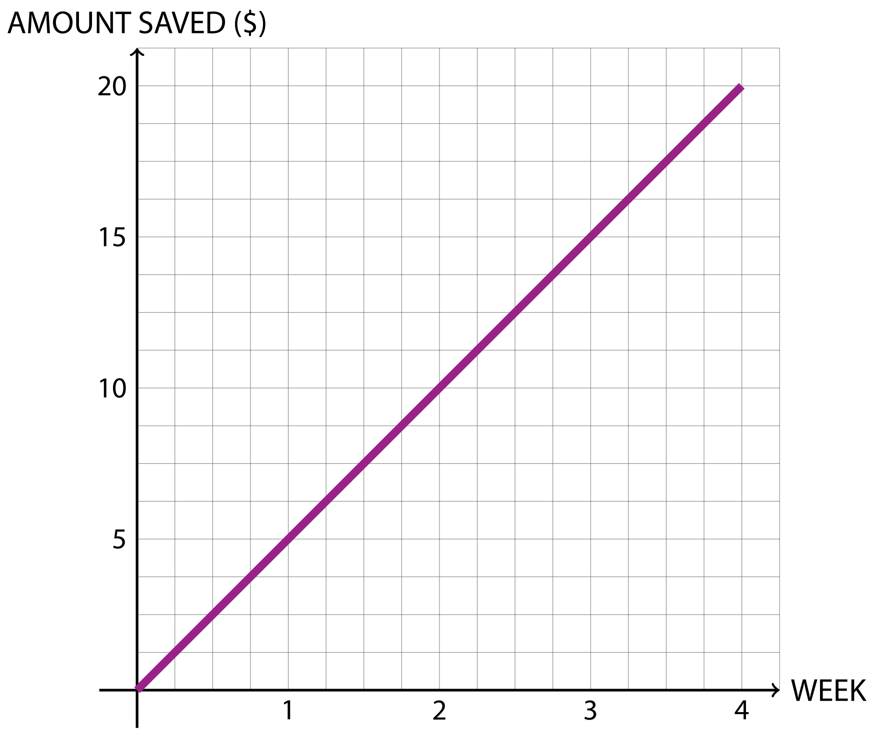
- Over your final hour fishing, you steadily caught your last 10 oama, reaching your bag limit for the day.

On the Cartesian plane below, graph how this day of fishing might look in terms of the number of fish caught over time.



**Activity 2.7**

You and two of your friends are saving up for some new fishing gear. Kainoa saved up his money and showed you how much he saved on a graph.




Lilo saved up some money too, but showed you her savings in a table:

| Week | Total amount saved |
|---|---|
| 1 | \$4.50 |
| 2 | \$9.00 |
| 3 | \$13.50 |
| 4 | \$18.00 |

You also saved some money, but you saved the same amount of money every week for 4 weeks. You modeled your savings with the equation: $s = 5.5w$, where $s$ is how much you saved and $w$ is the number of weeks.

Among the three of you, who was able to save the most amount of money each week, and who saved the least amount per week? Please explain how you got your answer.

# Unit 3: Solving Equations and Systems of Equations

**Activity 3.1**

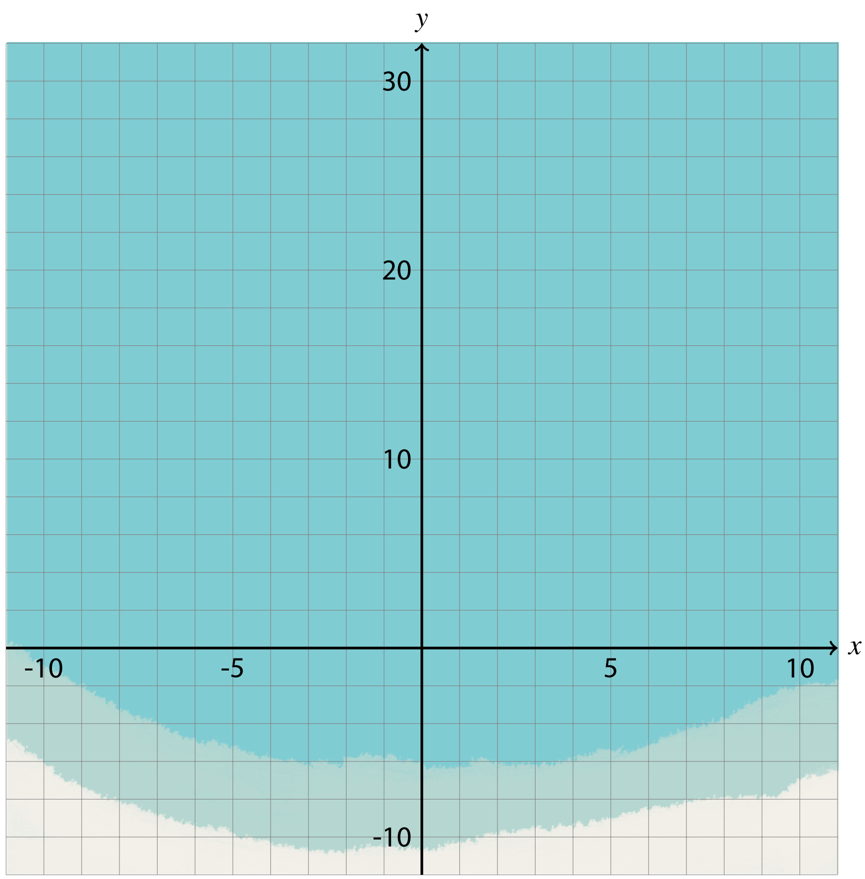
When bottom fishing, some fishermen use their arm length to estimate the lengths of their fishing lines. A normal bottom fishing set-up consists of taking your arm length and adding 6 inches to that. You then double this length to make 60 inches. Write out an algebraic equation to describe this, and use that equation to find how long your arm length is.

**Activity 3.2**

Among the fishing community, it is common to keep your favorite fishing spots a secret. This prevents overfishing at these spots. A couple of your friends have decided to shared their favorite spots in a bay by giving two equations each—their fishing spot is supposed to be at the intersection of the two equations. Find the intersections of the following equations (if you can!), and see if they were honest or lying in telling you their secret spot.

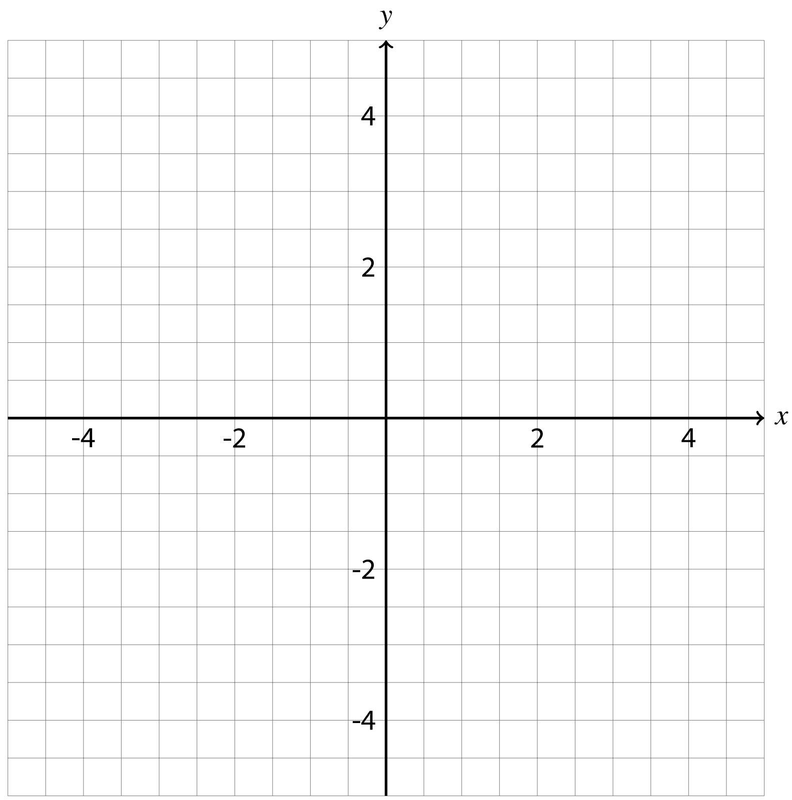
| Friend | Equation 1 | Equation 2 | Solution | Lying or honest? |
|---|---|---|---|---|
| Lani | $y = 2x + 10$ | $y = 10$ | | |
| Aloha | $y = 10x + 15$ | $y = 10x - 10$ | | |
| Koa | $y = 5x - 2$ | $y = \dfrac{15x - 6}{3}$ | | |
| Malu | $y = -6$ | $x = -5$ | | |

Below is the bay with a Cartesian plane. Check your answers by graphing the lines on the plane.



**Activity 3.3**

A modern GPS (Global Positioning System) can accurately pinpoint your location and track your progress throughout a day. Your GPS data shows that on your last two fishing trips, you traveled in straight lines and found a great fishing spot on both days at the point (-3, 2). To get to that point quickly, you decide to travel in a straight line from the shore (represented by the $x$-axis). Find *two* possible paths to get to your fishing spot (write the equations). Graph your paths and the point where you want to end up.




Did you just form a system of linear equations? How do you know?

**Activity 3.4**

Suppose that you want to buy fishing hooks online, and the shipping cost is always the same no matter how many hooks you buy at a time.

Last month, you bought 500 hooks for $13.00 (including shipping). This month, you bought 5000 hooks for $83.00 (including shipping).

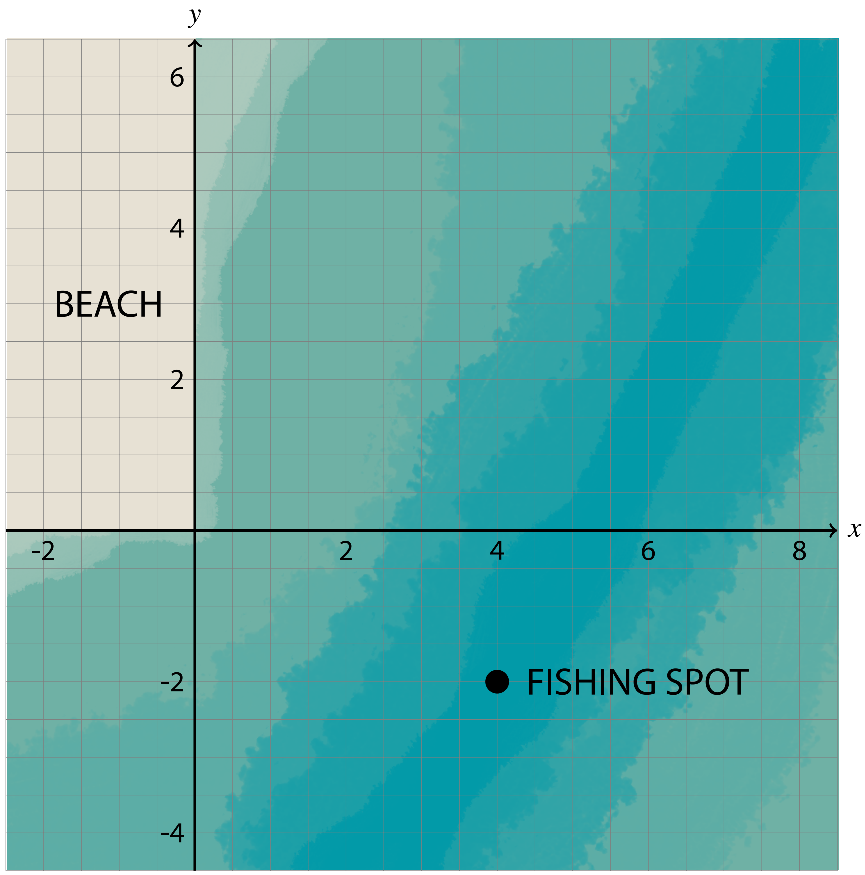
What is the cost for each hook, not including the shipping charge?

What is the cost of the shipping?

What is the cost for $n$, number of hooks?

**Activity 3.5**

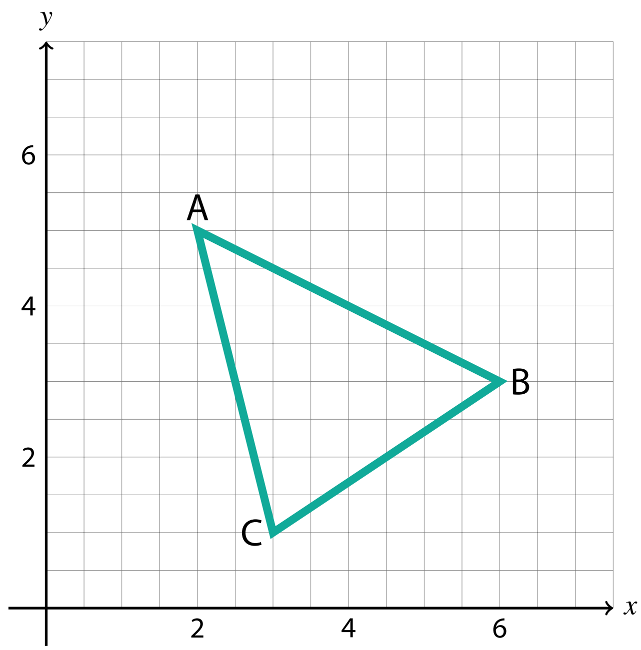
Your family is on a fishing trip, and you decide to catch something for dinner. Your favorite fish to eat is papio, which live in a channel that runs diagonally to the beach where you're standing. There's a particularly nice fishing spot in the channel, shown on the graph at point (4, -2). You want to cast your line from the beach straight to the fishing spot. You also want the slope of your fishing line's equation to be *greater than -1*. Graph two possible fishing lines.



# Unit 4: Transformational Geometry

**Activity 4.1**

Lay nets are a type of rectangular net with weights along one edge and floats on the opposite edge. When you lay it in the water, it stands up like a fence. You usually set up your lay net in a triangle like in the picture below.

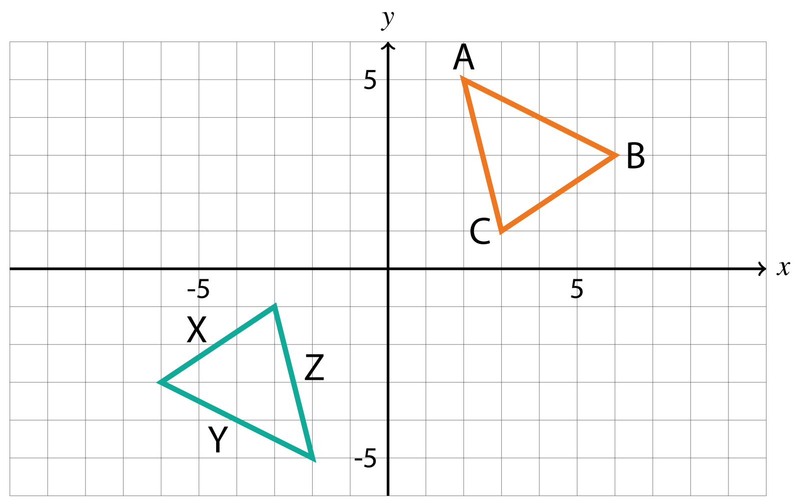



Your uncle gave you a larger lay net. Now that you have more netting material, you decide to take a look at your original setup and dilate it about the origin.

What could be a new possible location of point B in the bay? Please explain your reasoning. Is this the only possible position? Explain.

**Activity 4.2**

Lay nets are placed in triangles surrounding two different fishing holes in a bay.

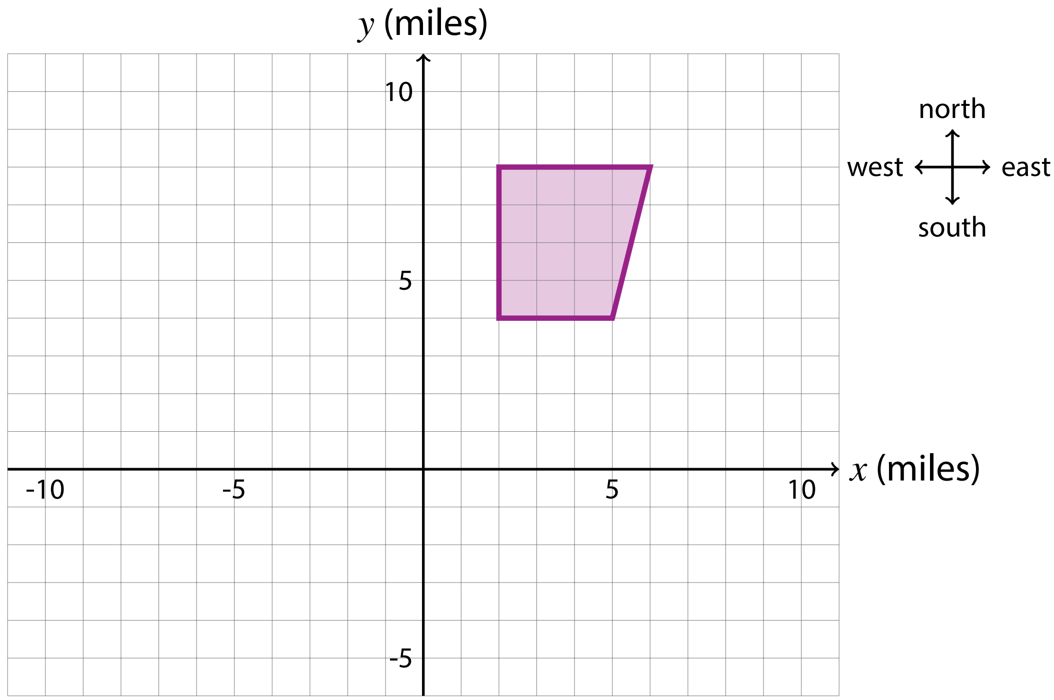



Check the appropriate boxes in the table to show which sides of the triangles have equal length.

| | X | Y | Z |
|---|---|---|---|
| AB | | | |
| AC | | | |

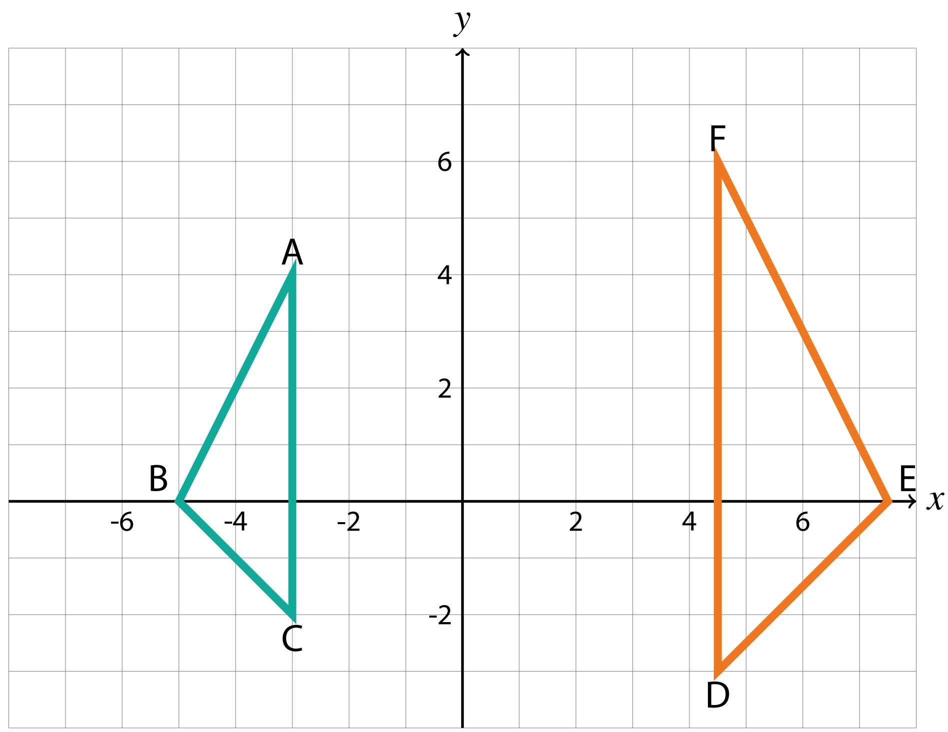
**Activity 4.3**

Rubbish piles floating in the ocean often attract small fish, which seek shelter under the rubbish. These small fish also attract larger predatory fish, which makes the rubbish piles good fishing locations. The shape on the graph below represents a rubbish pile. In a month, it will drift 4 miles south, and 5 miles west from its current location. Find the rubbish pile's new location and draw the rubbish pile on the graph.



**Activity 4.4**

You noticed over several months that your fishing grounds have been changing due to the current and waves. In the first month, you placed your net as the blue triangle (ABC) below to surrounded a school of fish. In the second month, you had to move your net by a mathematical transformation. Finally, during the third month, you laid your net with the orange triangle (DEF) representing your net placement. Your net placements were similar triangles in all three months.




1. Create the second month's net placement by drawing a similar triangle to triangle ABC. Label this new triangle XYZ.

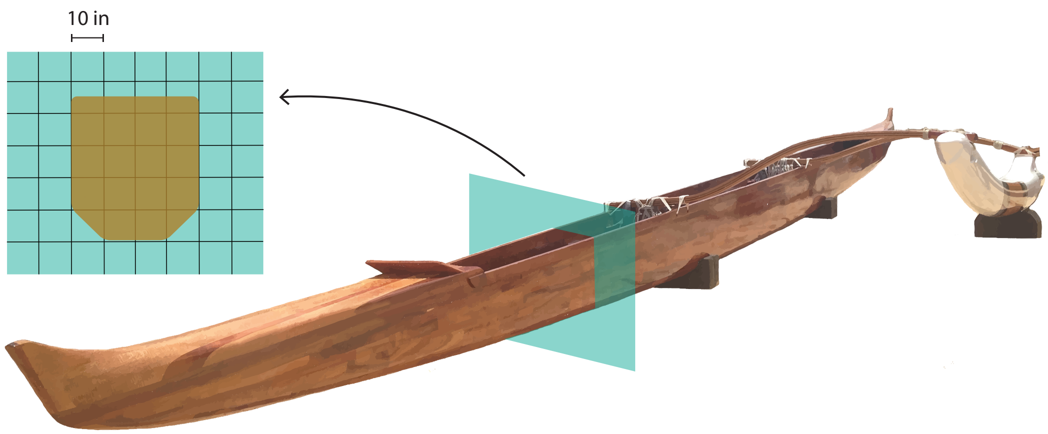
2. Describe how your second month's net layout could be obtained from triangle ABC with mathematical transformations.

3. Describe the mathematical transformation to obtain triangle XYZ from triangle FED.

4. Are the blue and orange triangles congruent? Explain your reasoning.

**Activity 4.5**

While designing your new canoe, you and your friend agree that the canoe should be symmetric when looking at it from the front.




The two of you are sketching the design out on graph paper and discussing about the best way to make sure that it is symmetric. Then your friend says:

"If you reflect a polygon over the $y$-axis, then you just gotta keep the same $y$-coordinates, but take the opposite of the $x$-coordinates."

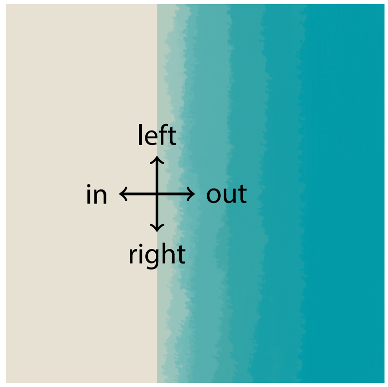
Is your friend's conjecture true?

*If it is true*, explain why the $x$ and $y$ coordinates become opposite/stay the same. You may also graph a few examples to make your explanation clearer. *If it is false*, provide an example.

# Unit 5: Measurement Geometry

**Activity 5.1**

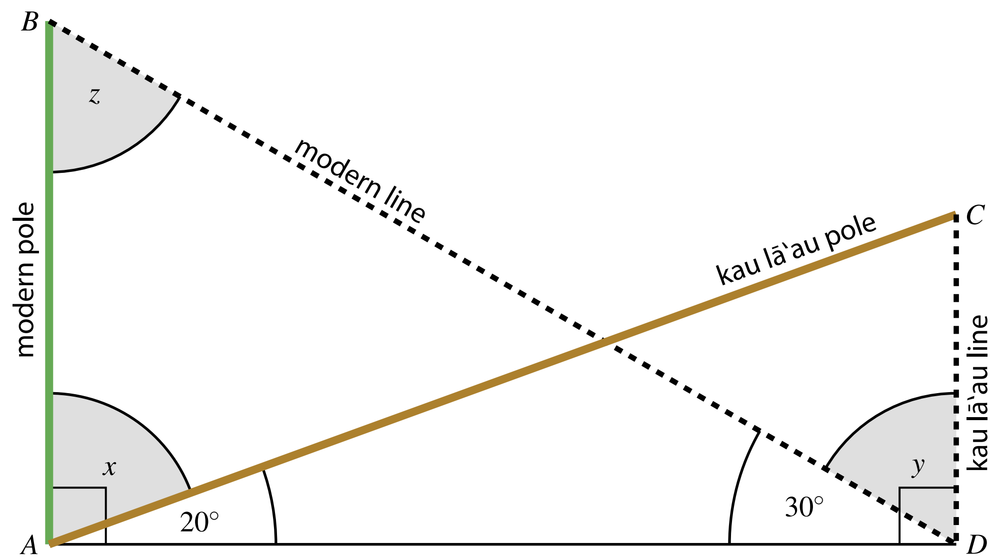
You want to lay a net in a straight line from where you are on the water's edge to a point that is 15 feet straight out and 8 feet to that position's right. How long a net do you need?



**Activity 5.2**

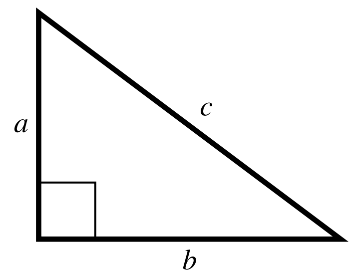
Ancient Hawaiians didn't use fishing reels—not even when catching *ulua* (a large predatory reef fish). Instead, Hawaiians used a traditional method was called *kau lāʻau* "hang stick". Check out this YouTube video on Hawaiian ulua fishing: `http://bit.ly/2pTqTs2`.

Kau lāʻau involves using a long stick with a rope at the end, which hangs a bait directly below it. Below is an image of a modern pole, represented by the line segment $AB$ and its fishing line represented by $BD$. The pole used in the kau lāʻau is represented by $AC$ and it's line $CD$. Find the angles $x$, $y$, and $z$.



**Activity 5.3**

When constructing a speargun, it is easiest to start with a block of wood that is a rectangular prism, like a long shoe box. Every angle of a rectangular prism is perpendicular, and you can check your angles with a special tool called a *square*. If you do not have a square, then you can make one with Pythagorean triples. We just need to get 3 pieces of wood each cut to a length of $a$, $b$, and $c$, such that $a^2+b^2=c^2$.




Find *two* sets of numbers (measurements) that our $a$, $b$, and $c$ sticks might have to make our square tool.

**Activity 5.4**

1. Fishing gear takes up a lot of room and organization really helps with getting your fishing set up ready. One common item among all fishermen is a tackle box. It is a box used to organize fishing gear such as hooks, swivels, lead, etc. Say you wanted to make your own tackle box which has a square bottom, a height of 1 inch, and a volume of 64 cubic inches. What should the dimensions of your final tackle box be?

2. Say you wanted a tackle box for your lures, which are quite big, and you wanted your box to be a cube with a volume of 1,000 cubic inches. What should the dimensions of the lure tackle box be?

**Activity 5.5**

You are looking online to buy a new cooler for your fishing trip. The website you are looking at has the following description of their coolers:

"These new *cube* coolers are perfect for fishing trips!. Get your coolers with the following volumes: 1 $ft^3$, 64 $in^3$, 96 $in^3$, 125 $in^3$, 200 $in^3$, 256 $in^3$, 333 $in^3$, 361 $in^3$!"

You want a cooler that has *integer dimensions*. Sort the coolers out in the following table to help you decide which cooler to get.

| A. Perfect square volumes (not perfect cubes) | B. Both perfect square and perfect cube volumes | C. Perfect cube volumes (not perfect squares) | D. Neither perfect cube nor perfect square volumes |
|---|---|---|---|
| | | | |

**Activity 5.6**

It is illegal to catch papio that are too small. In order to figure out how long it takes papio to grow to a legal catching size, you decide to raise some baby papio. To raise baby papio, you need to make a *cylindrical* tank with a volume between 100 and 120 cubic feet. Find 3 different possible configurations that will give you your desired tank size.

| | Tank #1 | Tank #2 | Tank #3 |
|---|---|---|---|
| Radius (feet) | | | |
| Height (feet) | | | |
| Volume (feet$^3$) | | | |

**Activity 5.7**

Native Hawaiians have always been excellent at building ponds for farming fish. In modern times, many societies raise fish in large cages or nets in ocean. When fish farming, it is important to consider the volumes of the cages. If we had a cone cage with a height of 27 feet and a base diameter of 32 feet but wanted a sphere cage with the *same volume*, then what should the radius of the sphere be?

**Activity 5.8**

Floaters are often used in fishing to keep baits and lures off of the ground. Some floaters float better than others and *how much something tends to float* is called *buoyancy*. The more volume an object has, the more buoyancy it also has. Suppose that you have two floaters: one is a sphere with radius of $r$, and the other is a right cylinder with a radius of $r$ and a height of $\frac{4}{3}r$. Does the sphere have a greater volume, the cylinder have a greater volume, or do they both have the same volume?

**Activity 5.9**

While out on a fishing and camping trip with your friends, a storm began to approach. So you and your friends rush to make a frame for your shelter. Between you and your friends, you have sticks of lengths $x$, $y$, and $z$ inches, such that $x < y < z$. You also notice that $x^2 + y^2 < z^2$.

One of your friends say that this is perfect and that you can create a right triangle to build part of your frame for your shelter. You, on the other hand, think that this is not correct and that you will have an obtuse triangle, which won't be good for your shelter since it won't be standing properly. Come up with a reasoning to justify who is right.

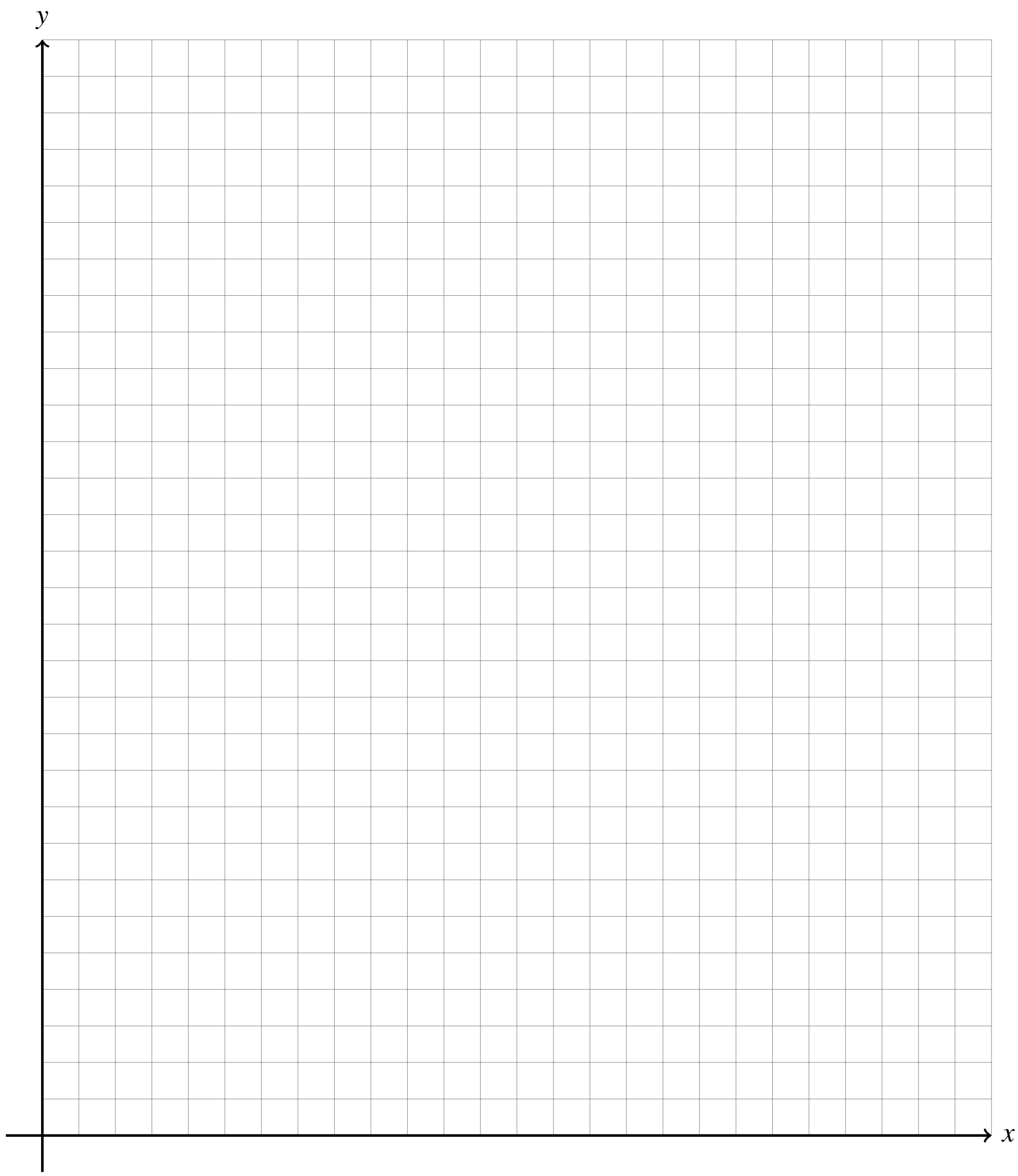
# Unit 6: Statistics

**Activity 6.1**

The following table shows the amount and weights of catches of oama.

| Number of oama caught | Weight of catch (oz) |
|---|---|
| 10 | 24 |
| 15 | 30 |
| 12 | 23 |
| 18 | 42 |
| 22 | 47 |
| 17 | 34 |
| 19 | 39 |
| 25 | 58 |
| 14 | 26 |
| 11 | 18 |

Construct a scatter plot of the data in the table on the graph below:




Draw a line of best fit on the graph for the data. Use this line to find how much more oama is needed to increase the weight of a catch by 40 more oz. Explain how you found your answer.

**Activity 6.2**

The price of fish changes a lot with "supply and demand." For example, in winter, ahi is normally not biting, so they're hard to catch and the *supply* is low. People want to eat more fish during the holiday season so the *demand* is high. So fresh ahi can get really expensive in the winter months. The "grade" or quality of the fish can also affect its price.

Let's assume that for each higher quality grade of fish, the price increased by 10%. Fill out the table below to create an example of how fish prices could depend on grade, with five star (★★★★★) fish being the best, and one star (★) being the worst. Start by choosing a cost for the one star (★) fish and work your way up.

| Fish grade | Cost per pound of fish ($) |
|---|---|
| ★ | |
| ★★ | |
| ★★★ | |
| ★★★★ | |
| ★★★★★ | |

After you have finished filling out the table, determine if prices are changing linearly with grade. Please explain why or why not.

**Activity 6.3**

Summer fishing trips are always a fun way to spend time with family and friends. As a reward for all your hard work during the school year, you can camp out, fish, and relax before heading back to school. Catching and eating fresh fish makes the experience all the more memorable. As much fun as fishing trips are, there can be a lot of planning that goes into it.

Let's plan a week-long fishing trip for your family of five (including you). You are asked to shop for delicious food and to pick a fun fishing location.

There's a store nearby that sells "meal packs." Three meal packs feed one person for one day.

| Meal pack | Description | Price | Total cost for your family |
|---:|---|---|---|
| I Stay Broke | Canned beans. Great for saving money! | $2.00 | |
| Maka'āinana | Spam and rice. The classics! | $2.50 | |
| Mouth Stay Broke | Kalua pig, salmon, and more. A local favorite! | $3.50 | |
| Fat Like Wallet | Everything. Never go hungry or unsatisfied. Eat like an ali'i. | $5.00 | |

1. What are some interesting things that you see about the prices of the "meal packs"?

2. For each meal pack, find out the total cost(s) to feed your family for the week. Fill out the table above. Explain how you found your answer.

The following fishing spots are all around the island, and we have to consider the quality and cost of each location. Your family decides to take your family's truck to transport everything for the trip, and the truck gets *20 miles per gallon*. The gas price is *$3.25 per gallon*.

Here's some information about each fishing spot.

| Fishing spot | Description | Distance away | Travel cost |
|---|---|---|---|
| 1 | Far and hardest to get to, but is full of fish and small wildlife. Secluded and very pretty. | 76 miles | |
| 2 | Far, but has a good amount of fish. Clean and not too crowded. | 43 miles | |
| 3 | Not too far. The fishing activity is okay. But a little crowded. | 22 miles | |
| 4 | Closest spot, but doesn't have a lot of fish. Crowded, a little noisy, and a little dirty. | 5 miles | |

Keep in mind that the travel time will affect your fishing and camping time.

3. Calculate how much it will cost to travel to each of the different fishing locations. Fill out the previous table. Explain how you got your answer.

4. Which meal pack(s) and which fishing spot would you choose? Justify your answer and find the cost of your fishing trip.