DMT INSTITUTE

Developing Mathematical Thinking Institute (DMTI)

Professional Development

Curricular Resources

Assessment

Jonathan Brendefur, PhD
jonathan@dmtinstitute.com

About the DMTI Modules

The DMTI modules are designed to guide classroom instruction and formative assessment for teachers implementing the DMTI curricular materials.

The lessons are not necessarily intended for a single day of instruction. Teachers are encouraged to use their professional judgement regarding pacing. A suggested number of weeks is provided.

DMTI Day Overview

Overall, each module highlights historical and/or cultural themes used to build the lessons. Each Day should start with a warm-up, one or two major components of a lesson, and a take-away.

Components of a DMTI DAY (whether 45, 60, or 90 minutes long)

Warmup (3-5 minutes)

Lesson Component – Problem Solving Situation

Lesson Component – Explanation of math concepts and ideas

Lesson Component – Varied Tasks

Lesson Component – Varied Practice

Takeaway (2-4 minutes)

DMTI Lesson Component Overview

Overall, each module highlights historical and/or cultural themes used to build the lessons. Each Lesson will focus on one or more of the following Lesson Components:

Lesson Component – Problem Solving Situation *(~3 to 10 minutes)*

Lesson Component – Explanation of Math Concepts and Ideas *(~3 to 5 minutes; explanation of math concepts and ideas (with historically, culturally relevant and mathematically accurate ideas)*

Lesson Component – Varied Tasks *(~10-20 minutes; Completed together, in small groups or individually)*

Lesson Component – Varied Practice *(~15-30 minutes; Enactive, Iconic, Symbolic or Context, Iconic, and Symbolic)*

Lesson Review *(After every few lessons a review with different questions – skill, problem solving, conceptual, and justification – will be incorporated as both practice and a formative assessment or checkpoint for teachers.)*

Grade 5

UNIT 7

PATTERNS AND GRAPHING

1-2 WEEKS

Module Sequence

Introduction: Language Needed for this Module

Lesson 1: Number Lines and Coordinates

Lesson 2: Coordinates

Lesson 3: Coordinate Practice

Lesson 4: Valles Caldera

Lesson 5: Coordinates and Shapes

Lesson 6: Shape Art Using Coordinates

Lesson 7: Patterns

Lesson 8: Graphing Fractions on a Line Plot

Lesson 9: Review

Language Needed for this Module

Here are some key technical terms students will need to be familiar with in order to fully understand the contexts and activities in this module.

Following are slides that allow for students to generate their own meaning for the terms with formal definitions provided at the end.

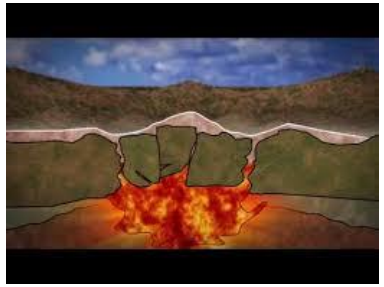
caldera

coordinates

graph

navigate

caldera



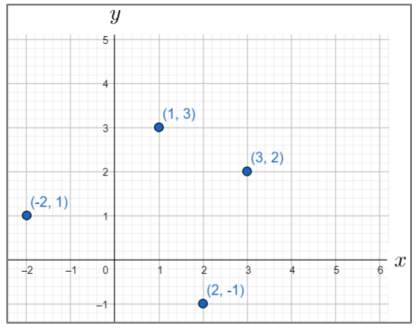
A **caldera** is created when the earth above hot magma caves in and a large hole is created in the landscape.

All of these pictures show **calderas.** The sentence below uses the word **caldera** correctly.

After thousands of years, the caldera filled with water and become a popular site for visitors to enjoy boat rides from one side to the other of the lake created inside the caldera.

1. What do you think a **caldera** is?

coordinates

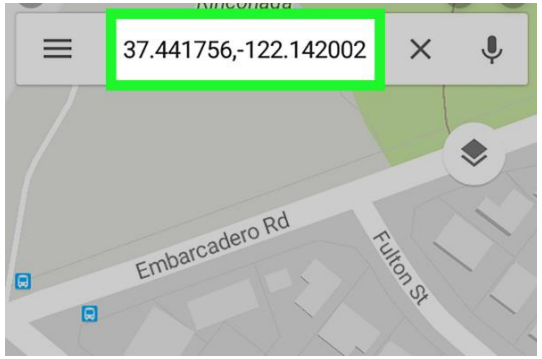


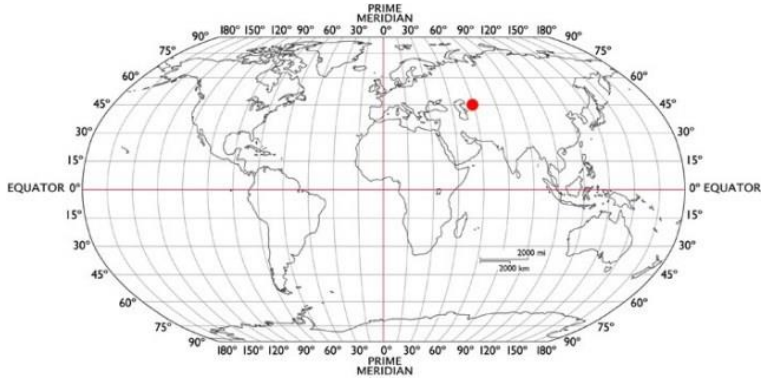
Coordinates are the points used to locate objects or places in space. In math, we use coordinates on a graph called the coordinate plane.

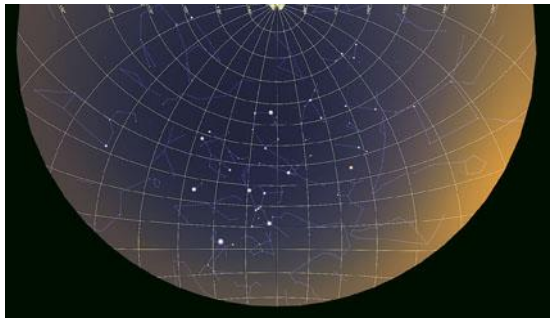
All of these pictures show **coordinates.** The sentence below uses the word **coordinates** correctly.

The airplane pilot was able to find a place to land by following the coordinates given to her by the nearest airport.

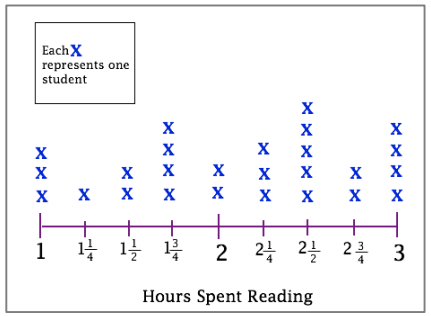
2. What do you think **coordinates** are?







graph

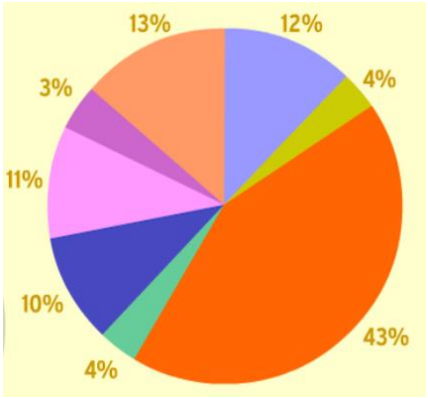


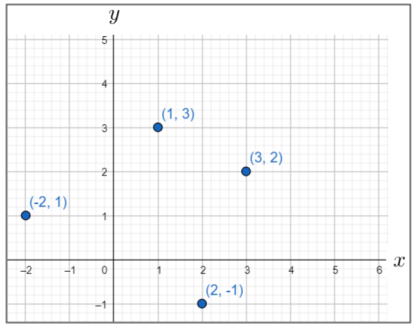
Graphs are a way to show information visually. The word *graph* comes from the phrase *graphical representation*.

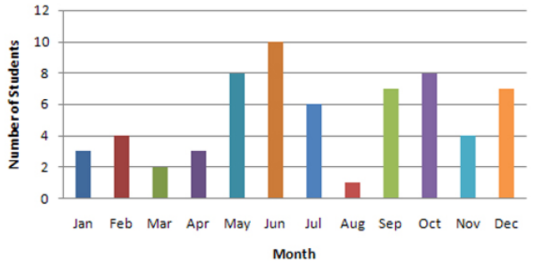
All of these pictures show **graphs.** The sentence below uses the word **graph** correctly.

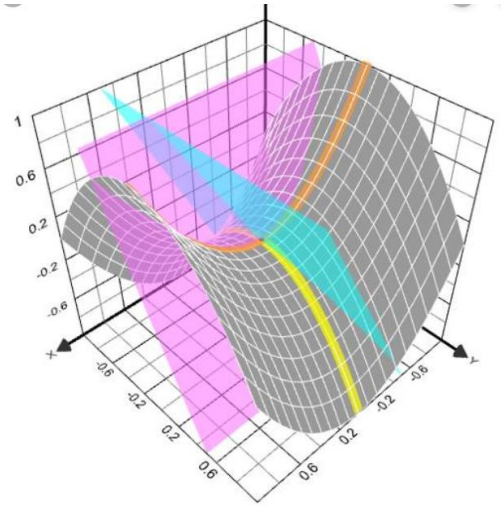
After recording the number of hours students in the 5th grade read each week, the class placed the data on a type of graph called a line plot.

3. What do you think **graphs** are?

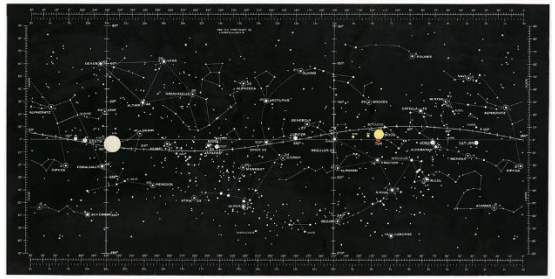








navigate

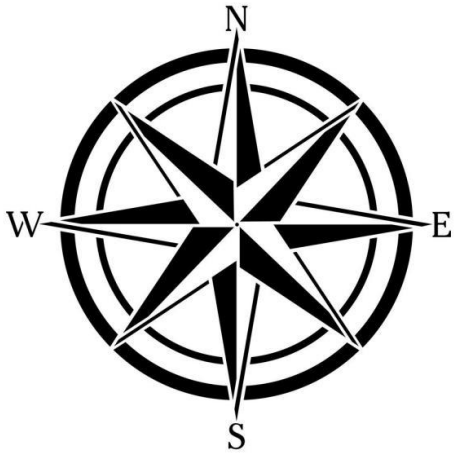


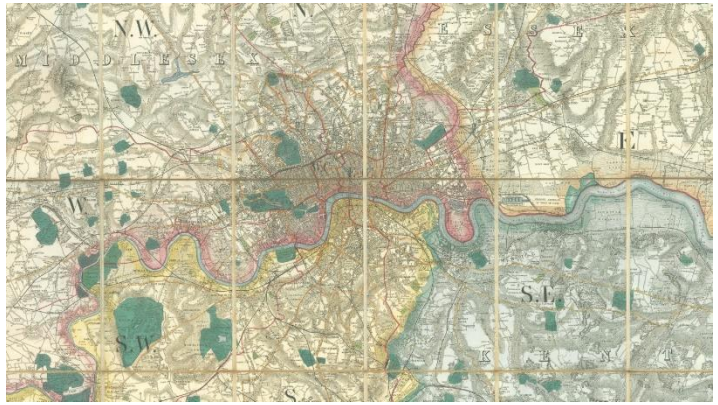
To **navigate** means to travel and find your way across land, sea or space. Many ancient people navigated using stars to give them directions to follow.

All of these pictures show what it means to **navigate.** The sentence below uses the word **navigate** correctly.

The Polynesian people were some of the first humans to learn how to navigate ships across the ocean. They used the stars to navigate from one island to another.

4. What do you think it means to **navigate**?





Warmup

Count from 0 to 12 and back down.

There are 12 months in the year.

Now count each month by a fraction of 1 year (0 to 1 by $\frac{1}{12}$ units and back to 0)

$$\frac{0}{12} \quad \frac{1}{12} \quad \frac{2}{12} \quad \frac{3}{12} \quad \frac{4}{12} \quad \frac{5}{12} \quad \frac{6}{12} \quad \frac{7}{12} \quad \frac{8}{12} \quad \frac{9}{12} \quad \frac{10}{12} \quad \frac{11}{12} \quad \frac{12}{12}$$

Now count each month by a fraction of 1 year converting to simplified equivalent fractions. (From 0 to 1 to 0)

$$\frac{0}{12} \quad \frac{1}{12} \quad \frac{1}{6} \quad \frac{1}{4} \quad \frac{1}{3} \quad \frac{5}{12} \quad \frac{1}{2} \quad \frac{7}{12} \quad \frac{2}{3} \quad \frac{3}{4} \quad \frac{5}{6} \quad \frac{11}{12} \quad 1$$

Warmup

Have students start from a standing position and then count how many times they can sit down and get back up in 1 minute.

Have each student record the number of times they were able to sit down in 1 minute.

Write a line with hash marks to be labeled later.

Find the students with the greatest and least number of sit downs and have them graph their data first to show the range in the classroom. Then, have students gradually fill in their data by placing the sticky notes in columns.

Warmup

Here is an example of how to construct the graph with sticky notes. Each sticky note represents 1 student.

Discuss the following questions about the rough draft of the bar graph you just created and write down your responses in a journal.

1. What was the difference between the largest and smallest data points?
2. What was the most common number of sit downs in the class?
3. Where do the data seem to cluster in groups?

Lesson 1

NUMBER LINES AND COORDINATES

Lesson 1: Number lines and Coordinates

Write down responses in your math journal to the following questions.

4. How fast do you think plants grow in 1 month, a 1 day, or an 1 hour?

Let’s think about a few specific types of plants.

5. How fast do you think the following plants grow?
   a. How fast do you think corn grows?
   b. How much does a tree (Juniper) grow?
   c. How fast do you think a flower (daisy) grows?

Lesson 1: Number lines and Coordinates

Add these facts to your notes in your journal.

Sweet corn grows about 12 feet in 12 weeks. So, corn grows about 1 foot per week or about 1.7 inches per day.

A juniper tree can grow 1 foot per year or about $\frac{1}{4}$ inch every week.

A daisy grows about 30 inches in 3 months, which is 10 inches in 1 month or about $\frac{1}{3}$ of an inch per day.

Lesson 1: Number lines and Coordinates

6. Create a bar graph of their heights at 1 week and 1 month. (Sweet corn is already completed for you.)

7. Describe the different patterns you notice in the graphs.

8. Estimation and rounding are acceptable.

Lesson 1: Number lines and Coordinates

Sweet corn grows about 12 feet in 12 weeks. So, corn grows about 1 foot per week or about 1.7 inches per day.

A juniper tree can grow 1 foot per year or about $\frac{1}{4}$ inch every week.

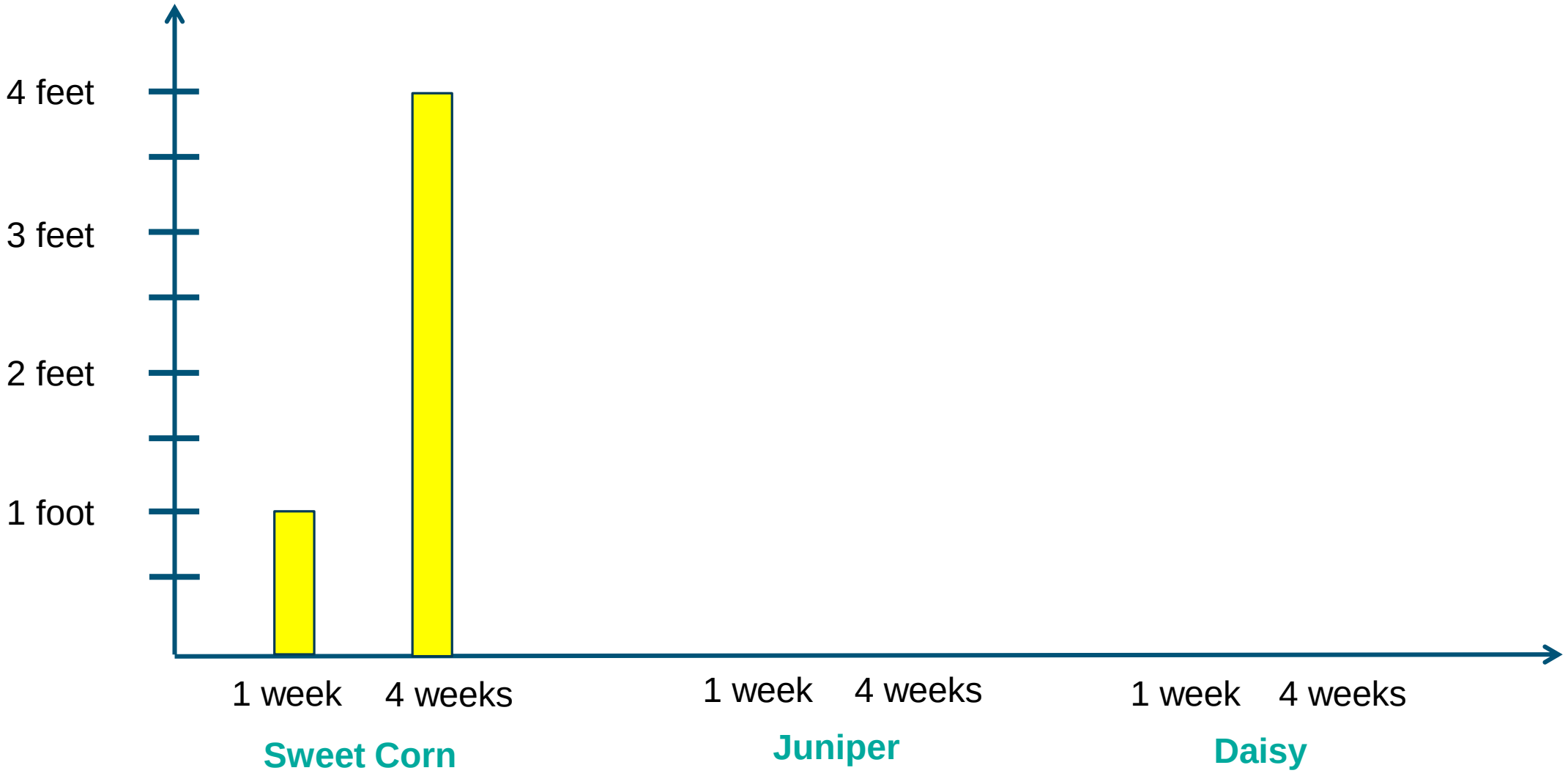
A daisy grows about 30 inches in 3 months, which is 10 inches in 1 month or about $\frac{1}{3}$ of an inch per day.

9. Create a bar graph of their heights at 1 week and 1 month. (Sweet corn is already completed for you.)

10. Describe the different patterns you notice in the graphs.

Estimation and rounding are acceptable.

Worksheet 1.1



Lesson 1: Number lines and Coordinates

The graph you created has the categories of plants on a **horizontal axis** (a number line that goes from left to right) and the height of the plants on the **vertical axis** (a number line that goes up and down.)

11. Create a ratio table that describes the growth of each plant at 1 month, 2 months, and 3 months.

12. Describe the growth pattern for each using a multiplication statement.

Lesson 1: Number lines and Coordinates

One of the fastest growing plants is bamboo. Given the right conditions, bamboo can grow 36 inches in 1 day.

13. Create a number line that shows the bamboo's growth over 1 day. Represent the growth at each hour of the day.

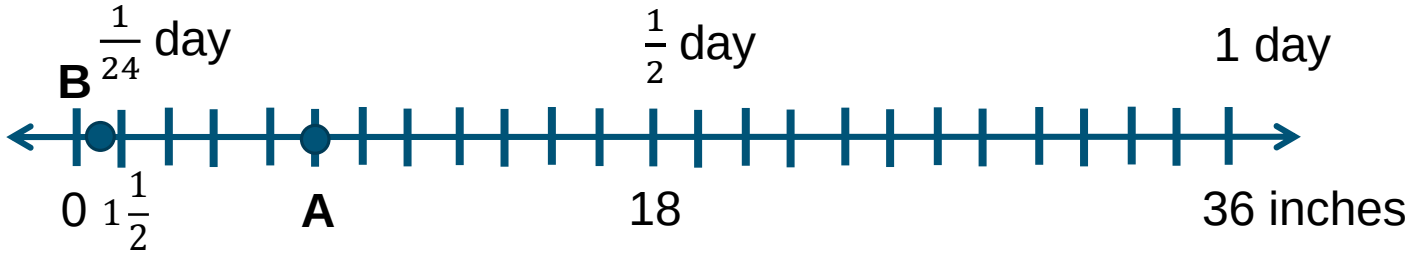
14. How much has the bamboo grown after 12 hours?

15. How much does the bamboo grow each 1 hour?

16. How tall would the bamboo be after 2 ½ days?

Lesson 1: Number lines and Coordinates

One of the fastest growing plants is bamboo. Given the right conditions, bamboo can grow 36 inches in 1 day.



17. Describe point A.

18. What is the value of point B?

Lesson 1: Number lines and Coordinates

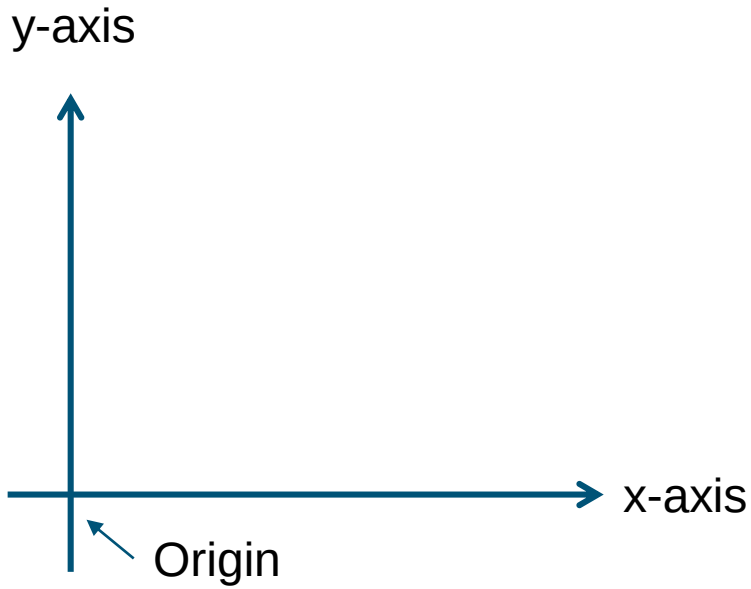
We have just used the number line to describe different points. The horizontal number line we used for describing the bamboo growth is called a **double number line** because it describes days and inches on the same number line. However, when we are describing two different but related situations, there is another graph we can create.

Follow the directions below.

Create a **horizontal number line** and label it the **x-axis**.

Now, create a **vertical number line** and label it the **y-axis**.

The point at which they intersect is called the **origin** and is the **0 point** for both lines.

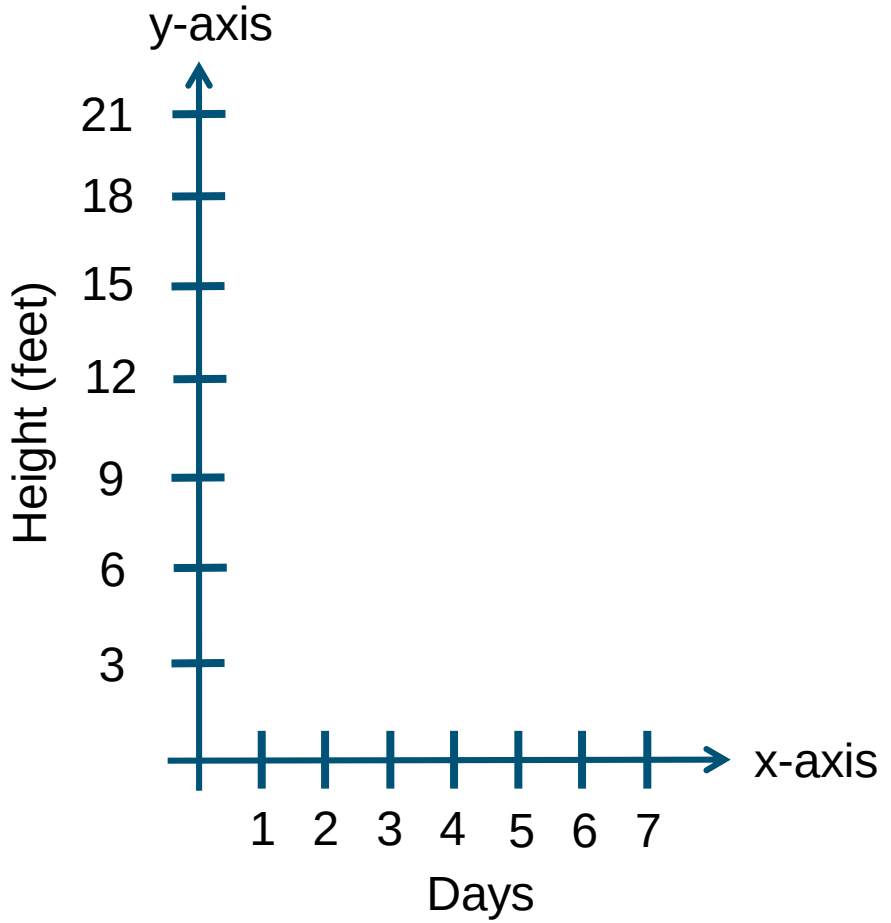


Lesson 1: Number lines and Coordinates

19. For the bamboo problem, let the x-axis represent time up to 7 days. Then, let the y-axis represent the height the bamboo plant grows up to 21 feet. Label each axis.

Your graph should look like the one to the right.

20. Plot a point where the height would be for 1 day.



Lesson 1: Number lines and Coordinates

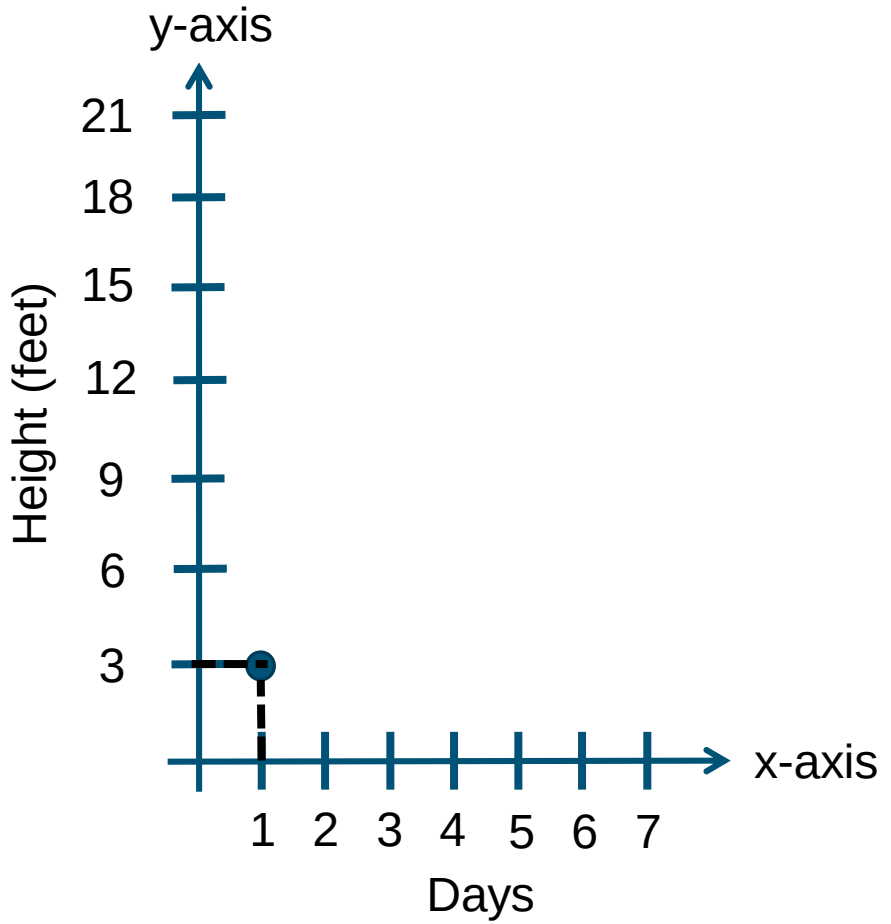
Here is where the point would be for 1 day. This **point** is called a **coordinate pair** and is written as (1, 21). The first coordinate is the distance on the x-axis: 1 day. The second coordinate is the distance on the y-axis: 21 inches. This point is called a **coordinate pair: (x, y).**

21. What is the coordinate pair for 216 inches?

22. What is the coordinate pair for 5 days?

23. What does the coordinate pair (0, 0) mean?

24. At 3.5 days, what would be the height of the bamboo in both feet and inches?



Lesson 1: Review and Takeaways

25. What are three ideas you remember from this lesson?

26. Define a coordinate pair.

27. Why are coordinates important? (Go back to the definition and use the words vertical and horizontal.)

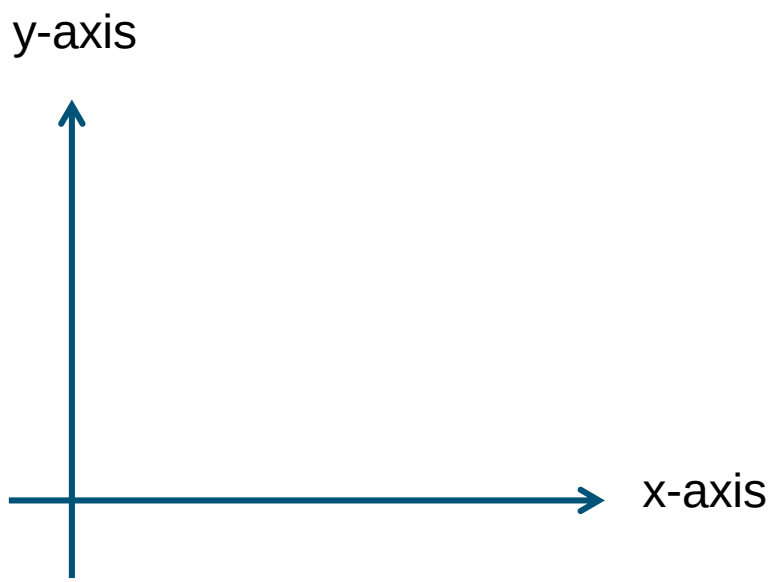
Lesson 1: Review and Takeaways

A daisy grows about 30 inches in 3 months, which is 10 inches in 1 month or about $\frac{1}{3}$ of an inch per day.

28. In your journal, construct a coordinate graph and plot the 3 coordinates given in the daisy situation.

29. What is the origin?

30. Julie says the distance from 0 to 10 inches is the x-coordinate. Explain why this is correct or incorrect.



Warmup: Quick Draws

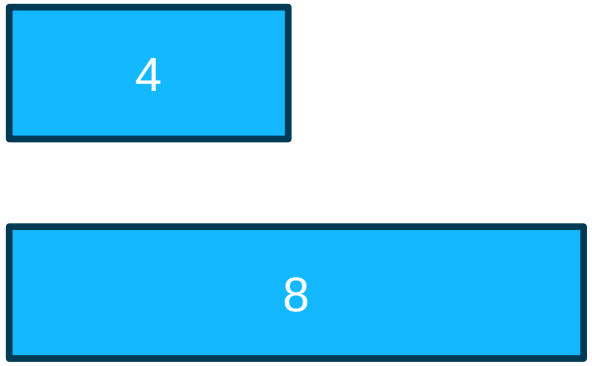
Complete the following Quick Draws.

These Quick Draws are intended to build number sense and proportional reasoning.

Warmup: Quick Draws

Draw this model.

If this is a model of 4, draw a model of what 8 would look like.

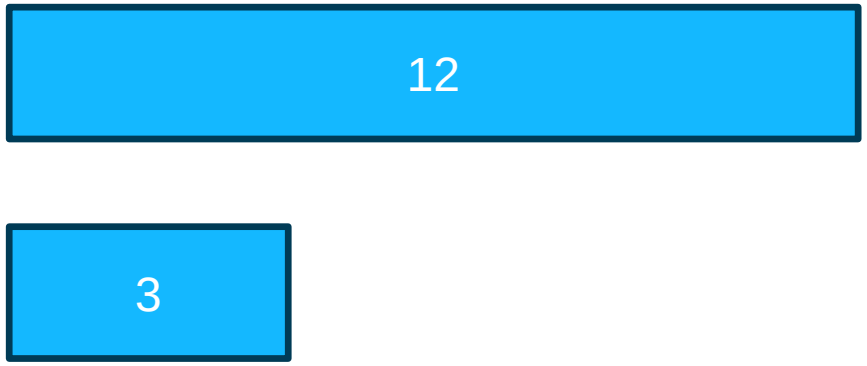


Use the terms *partition*, *iterate*, *compose*, *decompose* and *unit* to describe your drawing strategies.

Warmup: Quick Draws

Draw this model.

If this is a model of 12, draw a model of what 3 would look like.



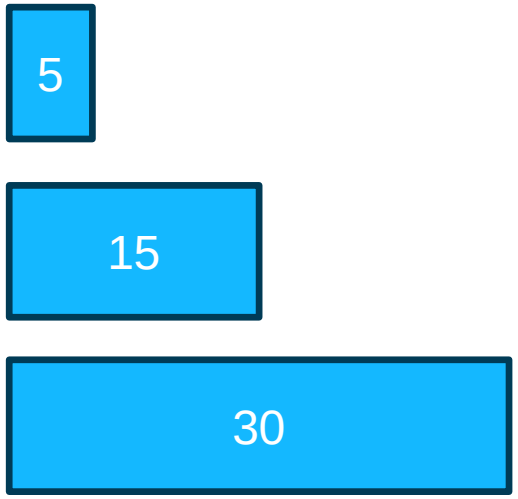
Use the terms *partition*, *iterate*, *compose*, *decompose* and *unit* to describe your drawing strategies.

Warmup: Quick Draws

Draw this model.

If this is a model of 5, draw a model of what 15 would look like.

What would 30 look like?



Use the terms *partition*, *iterate*, *compose*, *decompose* and *unit* to describe your drawing strategies.

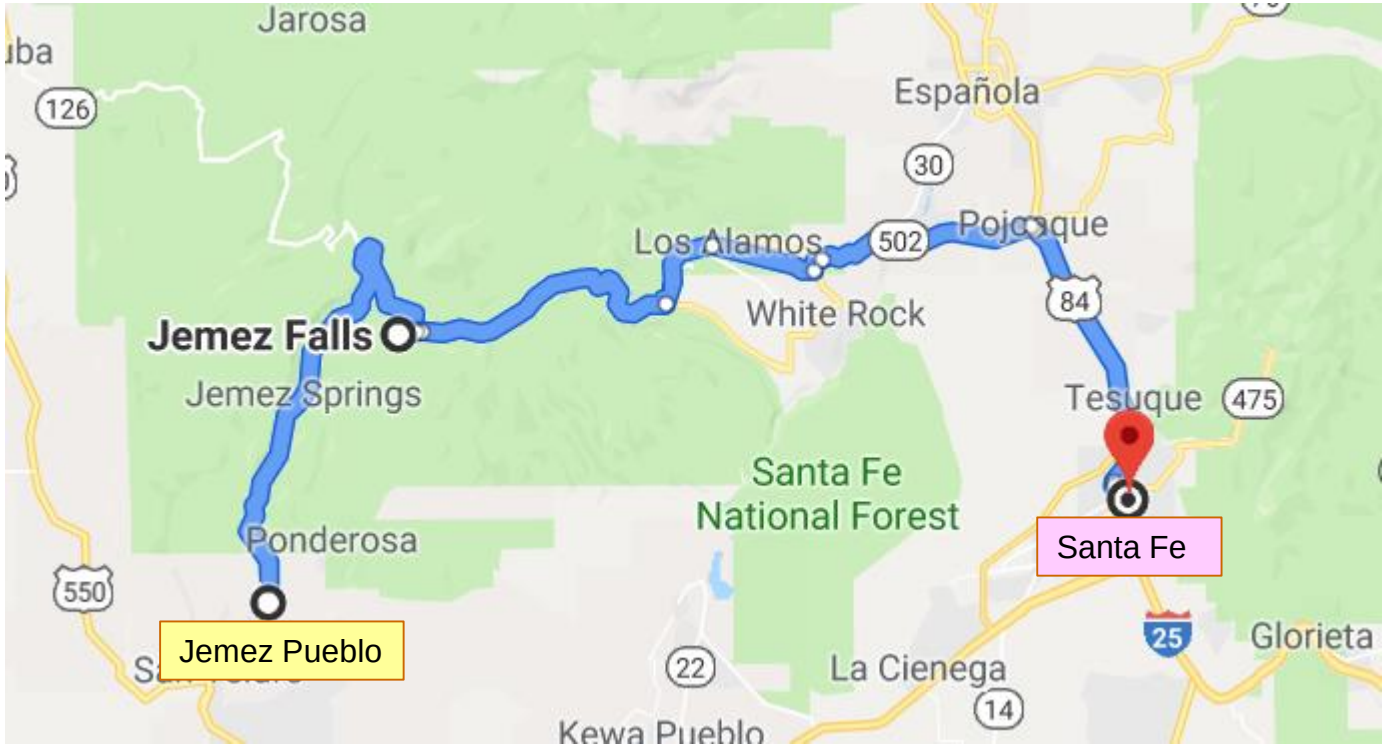
Lesson 2

COORDINATES

Lesson 2: Coordinates

Here is a map showing the driving directions from Pueblo of Jemez, through Jemez Falls to Santa Fe.

1. What do you notice about the route the map shows?
2. How much longer do you think the drive is than if you drove directly to Santa Fe from Pueblo of Jemez?

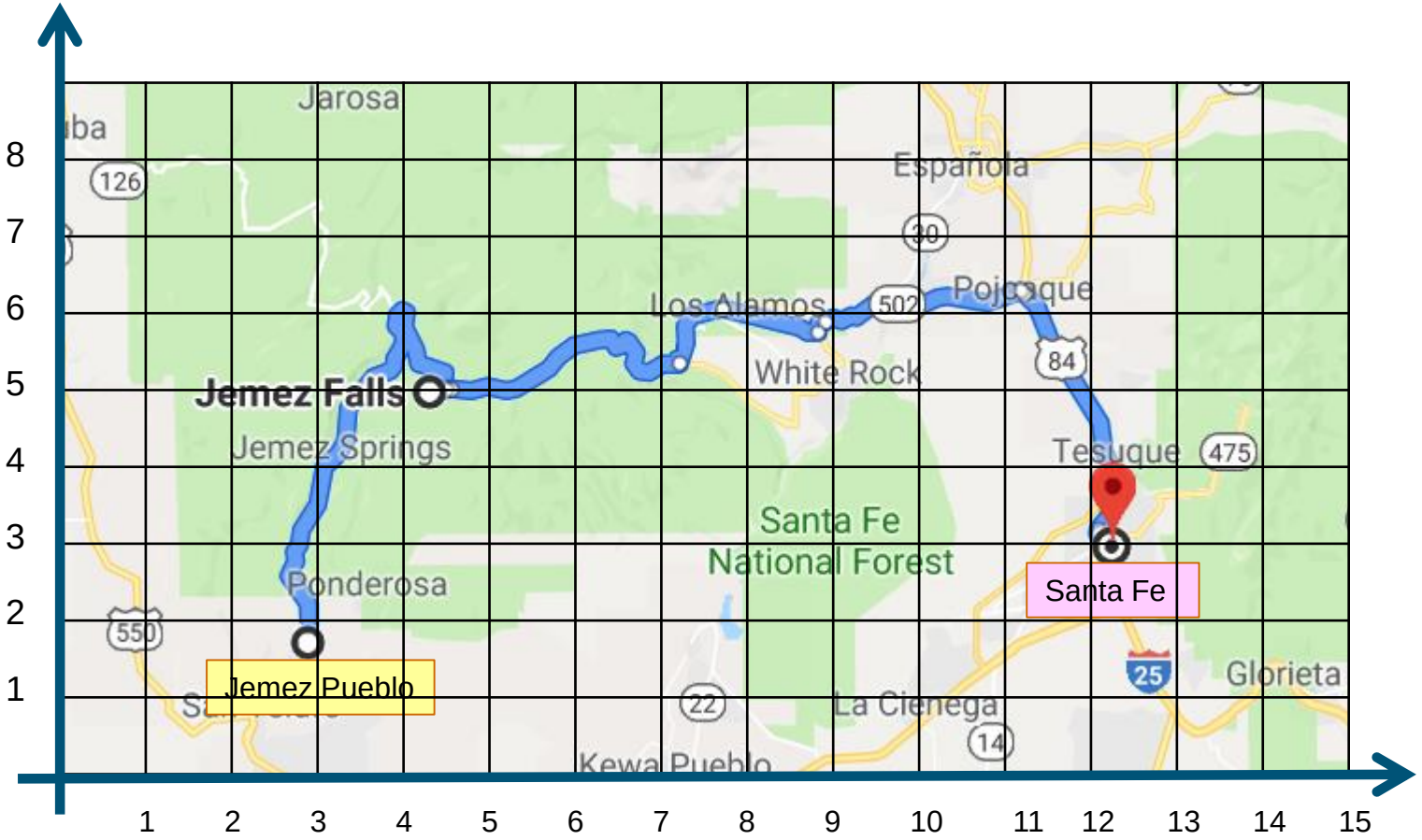


Lesson 2: Coordinates

If we place a coordinate grid over the top of the map, we can describe the locations of places using ordered pairs of coordinates.

3. Describe which town is nearest to the coordinate (11, 8).

Template 2.1



Lesson 2: Coordinates

Now, choose coordinates that are close to each of the following places to describe their locations with ordered pairs:

4. Jemez Pueblo

5. Jemez Falls

6. Santa Fe

Lesson 2: Coordinates

If you count each unit of length between the different locations on the map, how many units are the distances between the following places?

7. Jemez Pueblo to Jemez Falls

8. Jemez Falls to Santa Fe

9. Jemez Pueblo to Santa Fe

10. Jemez Pueblo to Santa Fe NOT following the blue driving route

Lesson 2: Review and Takeaways

11. Why are coordinate planes important?

12. How did we use a coordinates in this lesson?

13. What is something you will remember about this lesson?

Warmup

Everyone standup and find a little bit of room.

We are going to walk to using coordinates. Each step is 1 unit and should be the same going forward, backward, right or left.

Your starting point is the origin.

Start at (0, 0)
Walk to (0, 2)
Walk to (3, 2)
Walk to (3, 0)
Walk to (0, 0)

Start at (0, 0)
Walk to (4, 0)
Walk to (4, 1)
Walk to (0, 1)
Walk to (0, 0)

Lesson 3

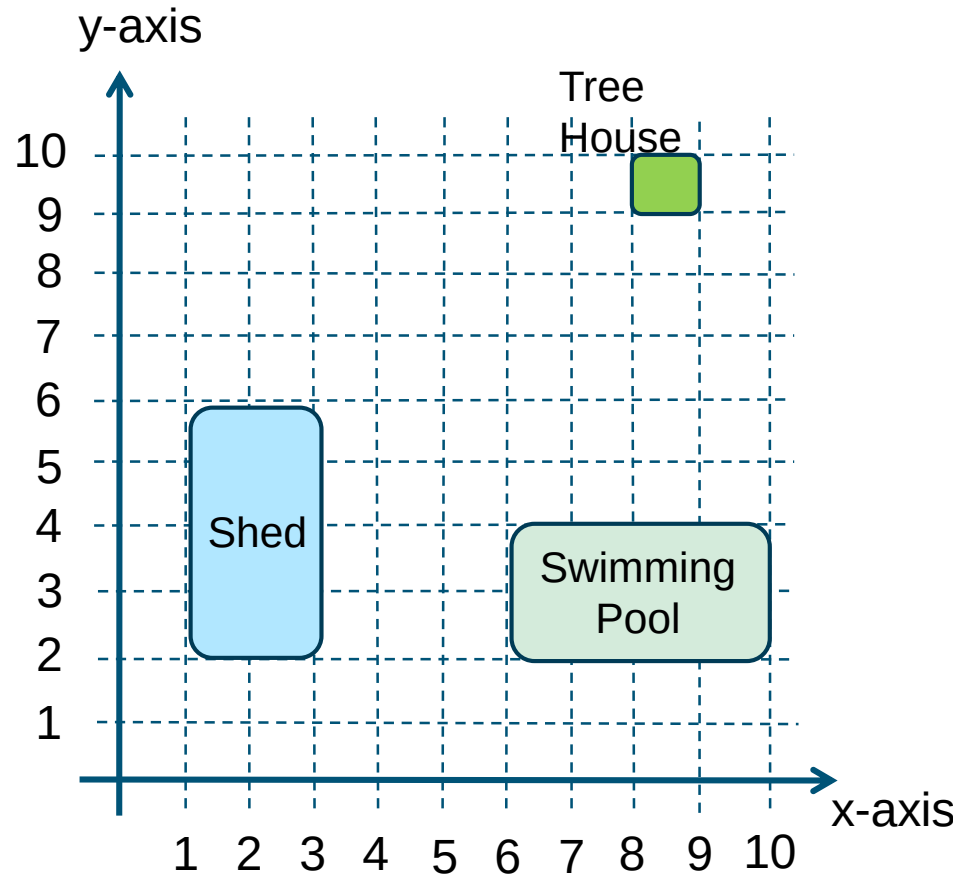
COORDINATE PRACTICE

Lesson 3: Coordinate Practice

To the right is the Baxters' backyard. Answer the following questions.

1. What are the coordinates of the corners of the shed, tree house and swimming pool?

2. Maranda noticed that the shed and the swimming pool had similar coordinates. Explain what she meant.

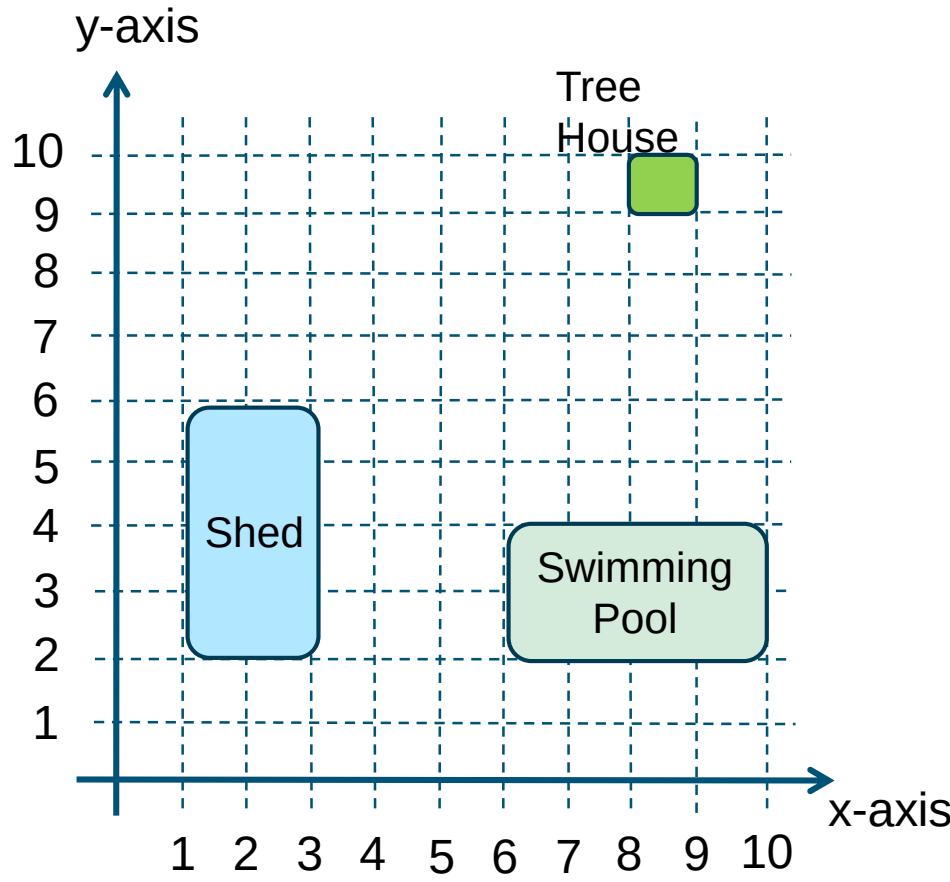


Lesson 3: Coordinate Practice

To the right is the Baxters' backyard. Answer the following questions.

3. If the origin is your starting point and you can only walk horizontally (left and right) or vertically (up and down), what is the shortest distance to the tree house?

4. Describe your walk to the tree house (question 3) using coordinates.

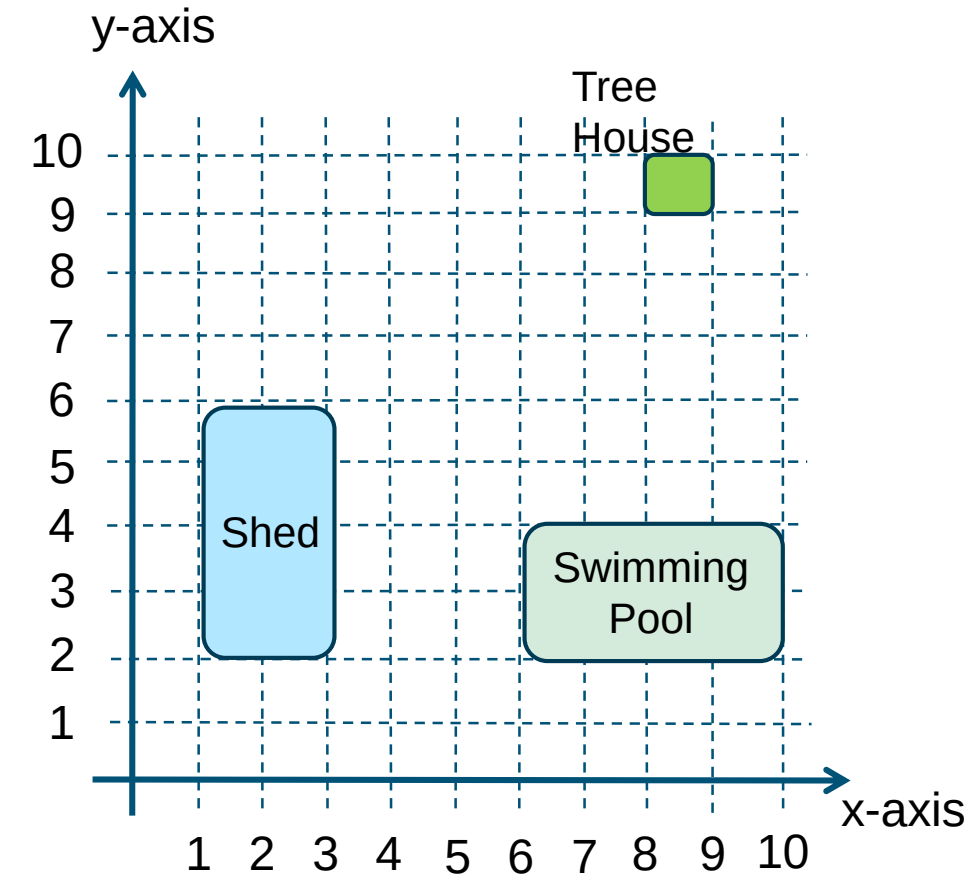


Lesson 3: Coordinate Practice

5. Describe the shortest path from the shed to the tree house to the swimming pool by listing the coordinates. Start at the top right corner of the shed.

6. If each unit on the coordinate graph is 3 meters, what is the width and length of the shed, swimming pool, and the tree house?

7. Jana walked from (1, 2) to (10, 2) to (10, 9) to (8, 9). Describe Jana's path (where she started and where she ended).



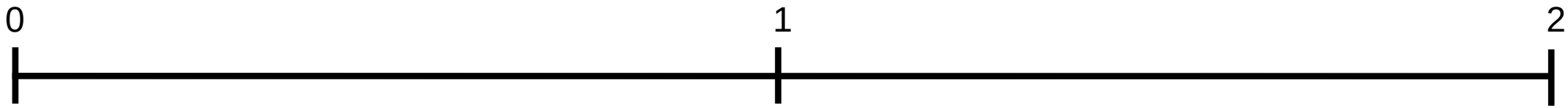
WARMUP ACTIVITY

Warmup: Number Line Quick Draws

Complete the following Quick Draws using number lines before starting the next lesson.

Let's practice using number lines to represent fractions.

Copy the drawing of the number line below that shows the length of 0 to 2.

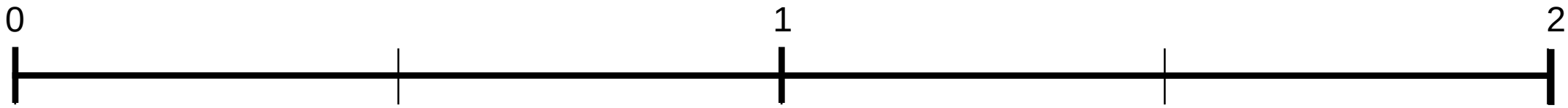


Every time you are shown the ***denominator***, ***partition*** the number line into that number of units. These will be the ***unit fractions*** we will ***iterate***.

Warmup: Number Line Quick Draws

Let's try an example. Partition *each whole unit of one* into the number of units that matches the denominator shown.

$\frac{}{4}$

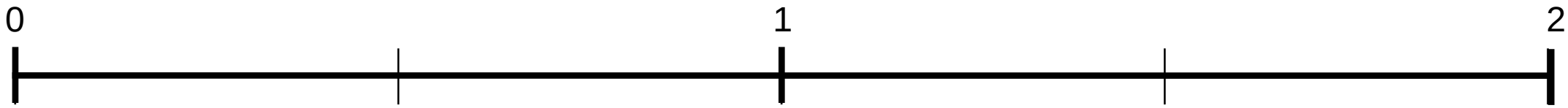


This is how Angeline partitioned the number line into fourths.
1. Do you think she is correct or incorrect? Why?
Start your explanation by saying, "I know she is correct (or incorrect) because….."

Warmup: Number Line Quick Draws

Let's try an example. Partition *each whole unit of one* into the number of units that matches the denominator shown.

$\frac{}{4}$

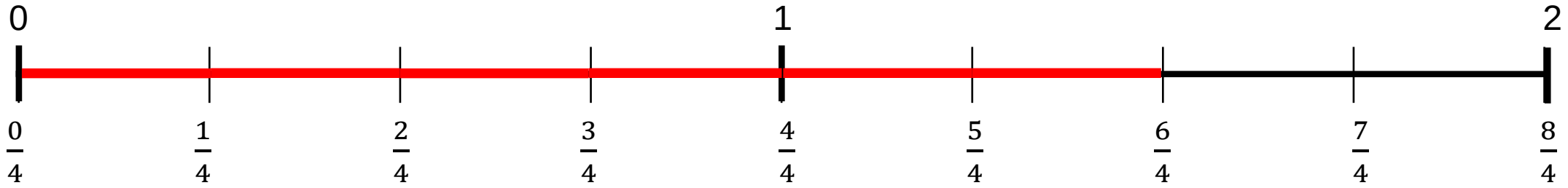


*"I know she is **incorrect** because the denominator of fourths means that each whole unit of 1 must be partitioned into four unit fractions. Angeline partitioned the whole length of 2 into four units and these are actually halves, not fourths."*

Warmup: Number Line Quick Draws

Here is the number line correctly partitioned into units of $\frac{1}{4}$. Notice that each whole unit of 1 is partitioned into four unit fractions.

*3. Now **iterate** units of fourths to find the length of this number.* → $\frac{6}{4}$



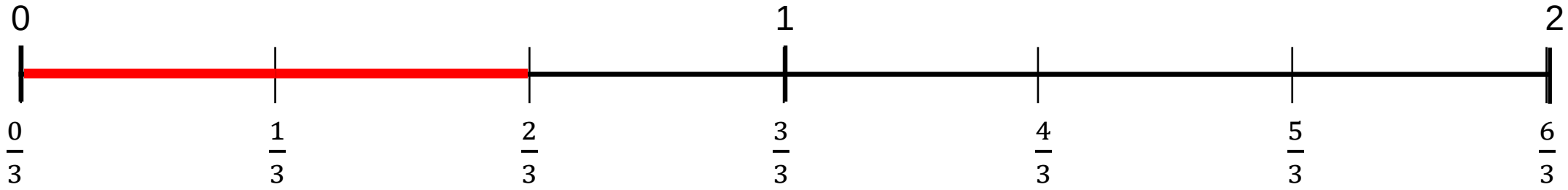
2. Label the unit fractions starting at $\frac{0}{4}$ and continue all the way to $\frac{8}{4}$.

Warmup: Number Line Quick Draws

Let's start again with a new number line from 0 to 2. Partition the number line into unit fractions that match this denominator:

*5. Now **iterate** units of thirds to find the length of this fraction.*

$$\frac{2}{3}$$

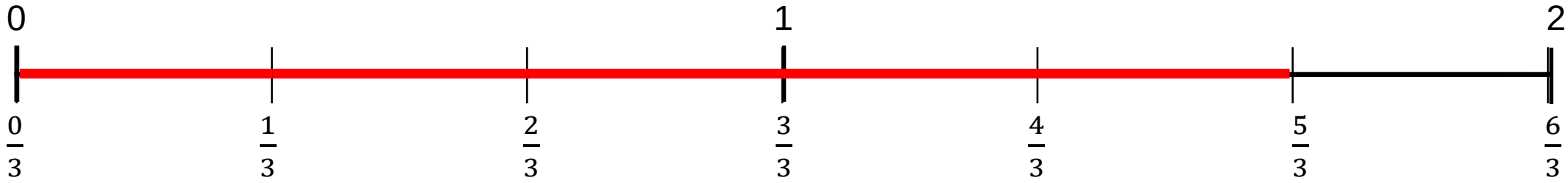


4. Label the unit fractions starting at $\frac{0}{3}$ and continue all the way to $\frac{6}{3}$.

Warmup: Number Line Quick Draws

Continue iterating ***units*** of thirds to ***compose*** the following fraction:

$$\frac{5}{3}$$



Warmup: Number Line Quick Draws

Now let's practice using the number line to model fractions.

For each fraction, start with a number line from 0 to 2.

As you are shown the denominator, partition your number line into that number of unit fractions. Remember that the denominator tells you the number of unit fractions within *each* whole unit of 1.

Then you will be given a numerator, which is the count of the unit fractions. You will iterate unit fractions to compose the fraction shown by the numerator and denominator.

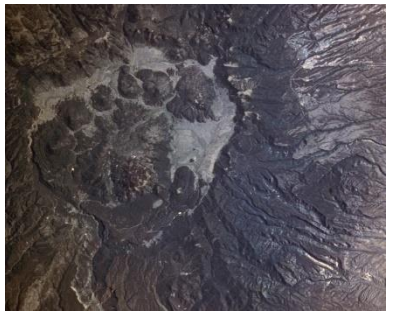
Warmup: Number Line Quick Draws

$\frac{4}{3}$ $\frac{3}{4}$ $\frac{7}{4}$ $\frac{5}{6}$ $\frac{2}{6}$

Lesson 4

VALLES CALDERA

From the air, you can see how the valleys and landforms of Valles Caldera are actually parts of one large caldera.



Lesson 4: Valles Caldera

The Valles Caldera area has been inhabited by the Jemez people for over 800 years. It is considered a holy land to the Jemez nation.

In 1860, the United States government took the Valles Caldera from the Jemez nation and gave it to settlers from far away.

In the year 2000, the U.S. government made the Valles Caldera a national park. This prevented the Jemez people from being the legal caretakers of the area. So today, the Jemez nation is seeking to regain control of the Valles Caldera and to have legal rights to protect their sacred land. Pueblo of Jemez legal experts are discussing the transfer of the land in the U.S. court system at this moment.

Lesson 4: Valles Caldera

One of the reasons many native tribes hold the Valles Caldera as sacred is it was a place they gathered **obsidian.**

Obsidian is a special type of rock that looks like black glass. It is made from lava inside volcanos. It can be used to make tools and weapons. It was very valuable to many tribes living near Valles Caldera many years ago.

These are cliffs of obsidian found in the Valles Caldera area.

Lesson 4: Valles Caldera

If you are looking for something in a large area, a ***map*** is a helpful resource to have. The ***coordinate plane*** can be used to show locations so we can use the graph over the top of the a picture of Valles Caldera to show important locations.

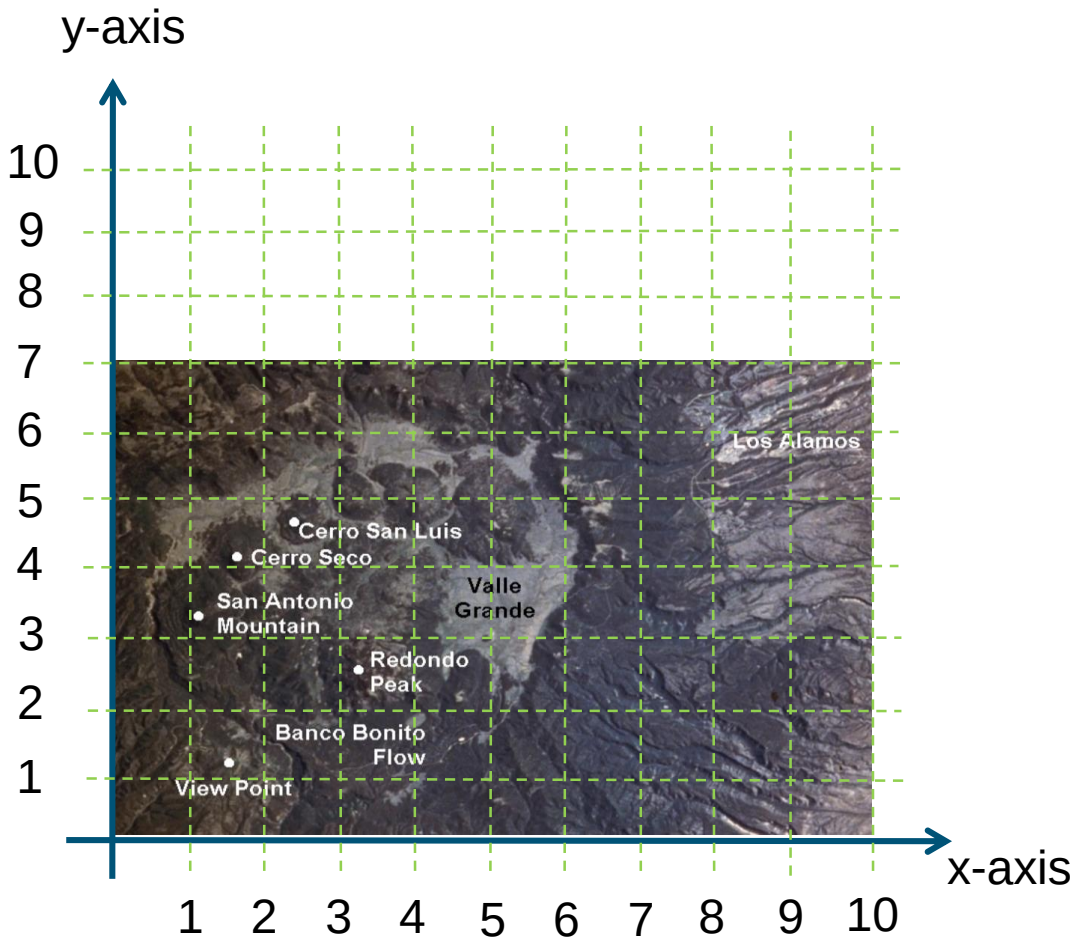
1. Look at the map to the right and record all of the closest whole number coordinates for the following places:

a. San Antonio Mountain

b. Los Alamos

c. Redondo Peak

d. Valle Grande



Lesson 4: Valles Caldera

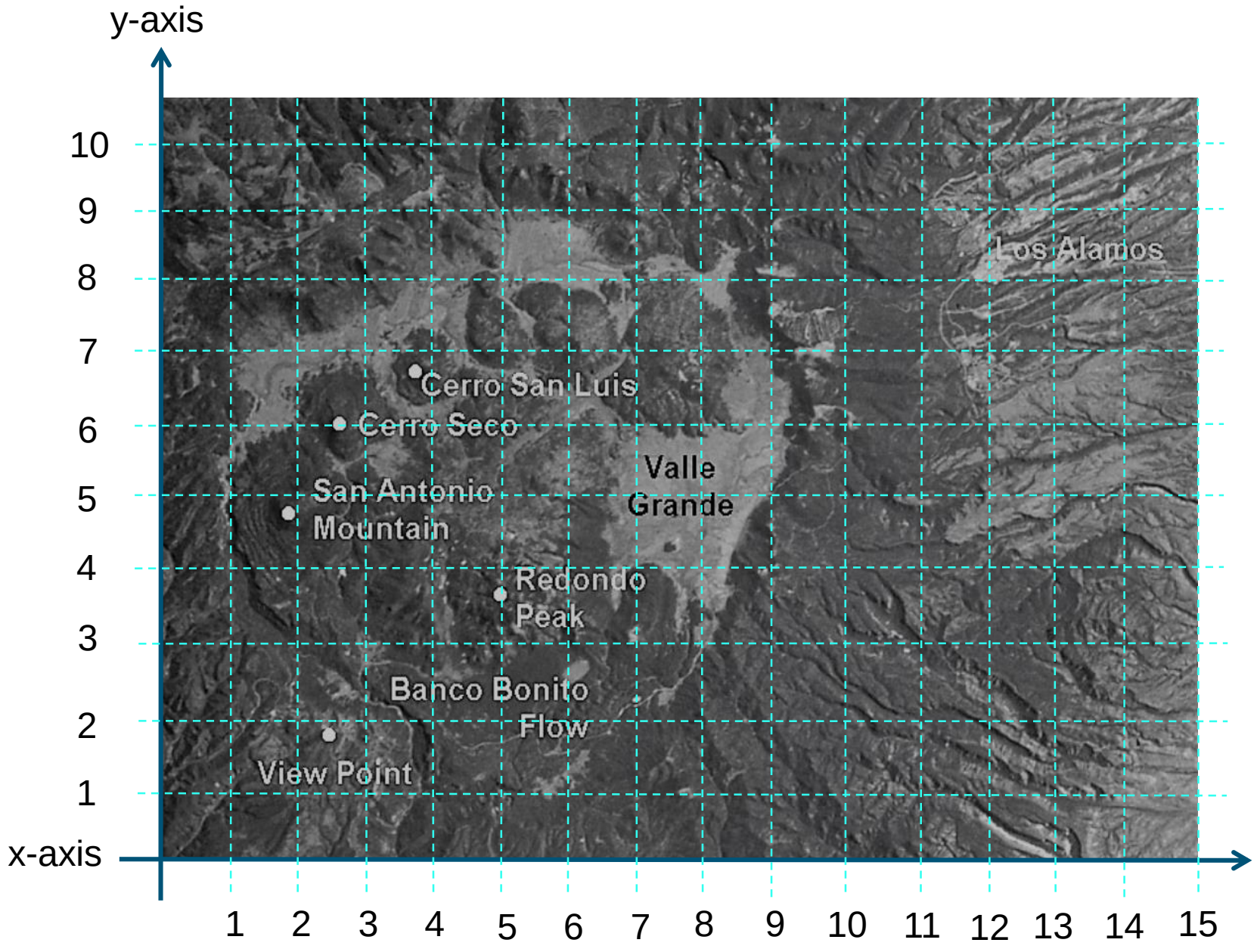
Imagine that you are looking for obsidian in the Valles Caldera land.

Use the coordinate plane and map of the area to answer the questions on **Worksheet 4.1**.

Worksheet 4.1

Name:_____

2. If you knew that obsidian had been found near Cerro San Luis, what would be an ordered pair of coordinates you should start traveling to?
3. If you wanted to travel from the San Antonio Mountain to Cerro San Luis to find obsidian, how many units of length on the map would you travel? Use only the lines on the graph, no diagonals.
4. Outline 3 different paths from San Antonio to Cerro San Luis that are the same length in units. Use the lines on the graph only.
5. If Redondo Peak is at (5,4) what coordinates you be at if you traveled from Redondo Peak 3 units to the right and 6 units up?



Warmup

Count from 0 to 12 and back down.

There are 12 months in the year.

Now count each month by a fraction of 1 year (0 to 1 by $\frac{1}{12}$ units and back to 0)

$$\frac{0}{12} \quad \frac{1}{12} \quad \frac{2}{12} \quad \frac{3}{12} \quad \frac{4}{12} \quad \frac{5}{12} \quad \frac{6}{12} \quad \frac{7}{12} \quad \frac{8}{12} \quad \frac{9}{12} \quad \frac{10}{12} \quad \frac{11}{12} \quad \frac{12}{12}$$

Now count each month by a fraction of 1 year converting to simplified equivalent fractions. (From 0 to 1 to 0)

$$\frac{0}{12} \quad \frac{1}{12} \quad \frac{1}{6} \quad \frac{1}{4} \quad \frac{1}{3} \quad \frac{5}{12} \quad \frac{1}{2} \quad \frac{7}{12} \quad \frac{2}{3} \quad \frac{3}{4} \quad \frac{5}{6} \quad \frac{11}{12} \quad 1$$

Lesson 5

COORDINATES AND SHAPES

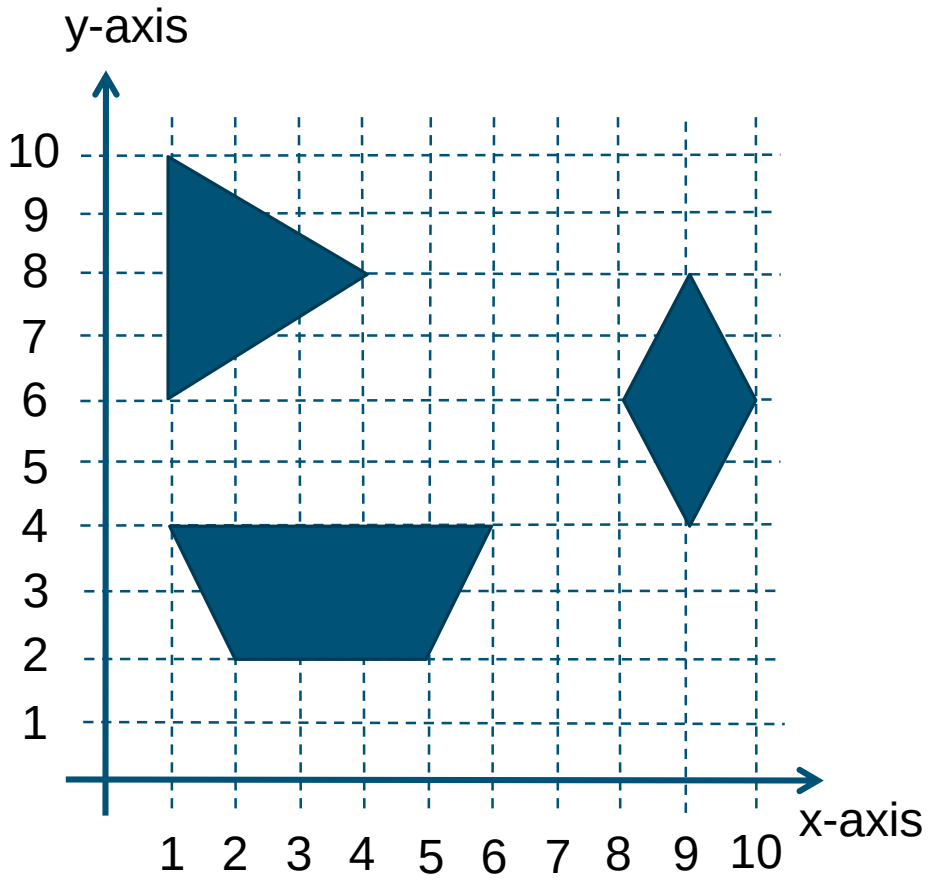
Lesson 5: Coordinates and Shapes

1. What are the coordinates of the triangle's vertices?

2. What are the coordinates of the rhombus' vertices?

3. What are the coordinates of the trapezoid's vertices?

4. Name the coordinates of the line of symmetry for each of the shapes.



Lesson 5: Coordinates and Shapes

5. By just examining these sets of coordinate pairs, what shapes are created if lines are used to connect the points? Provide reasons for each shape.

a. (1, 7), (1, 10), (4, 10), (4, 7)

b. (0, 2), (3, 5), (6, 2), (3, 3)

c. (9, 5), (10, 7), (6, 7), (5, 5)

Lesson 5: Coordinates and Shapes

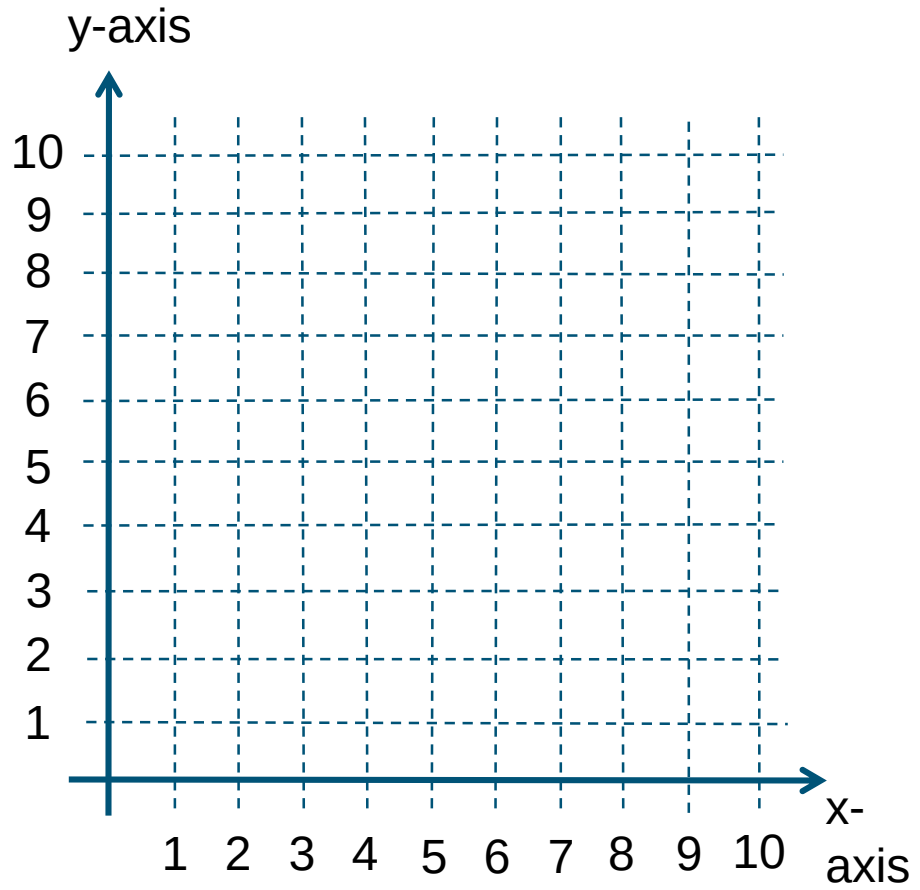
6. Graph each set of points and draw lines connecting each set (use Template 5.1).

   a. (1, 7), (1, 10), (4, 10), (4, 7)

   b. (0, 2), (3, 5), (6, 2), (3, 3)

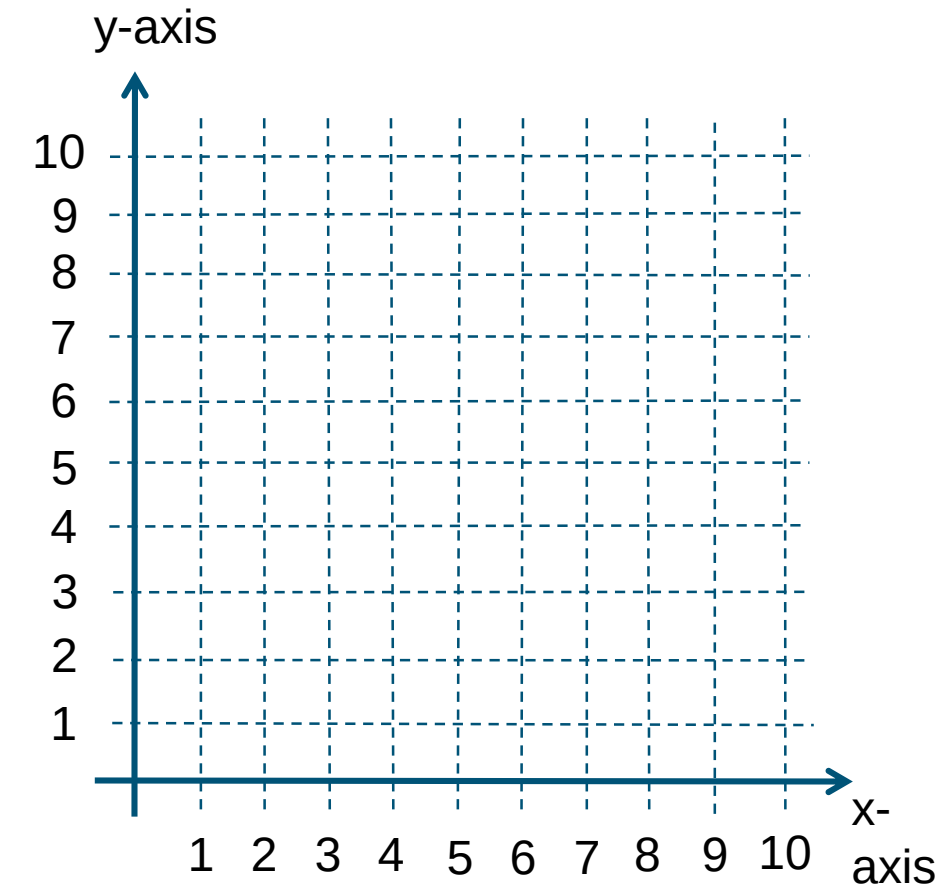
   c. (9, 5), (10, 7), (6, 7), (5, 5)

7. Were your predictions in question 5 the same as what you graphed for question 6? Explain what patterns you noticed.



Lesson 5: Coordinates and Shapes

8. Marco says that when you graph a square, all of the x-coordinates are the same as each other and all the y-coordinates are the same as each other. Prove whether Marco's statement would always be true. Provide some examples using the graph.



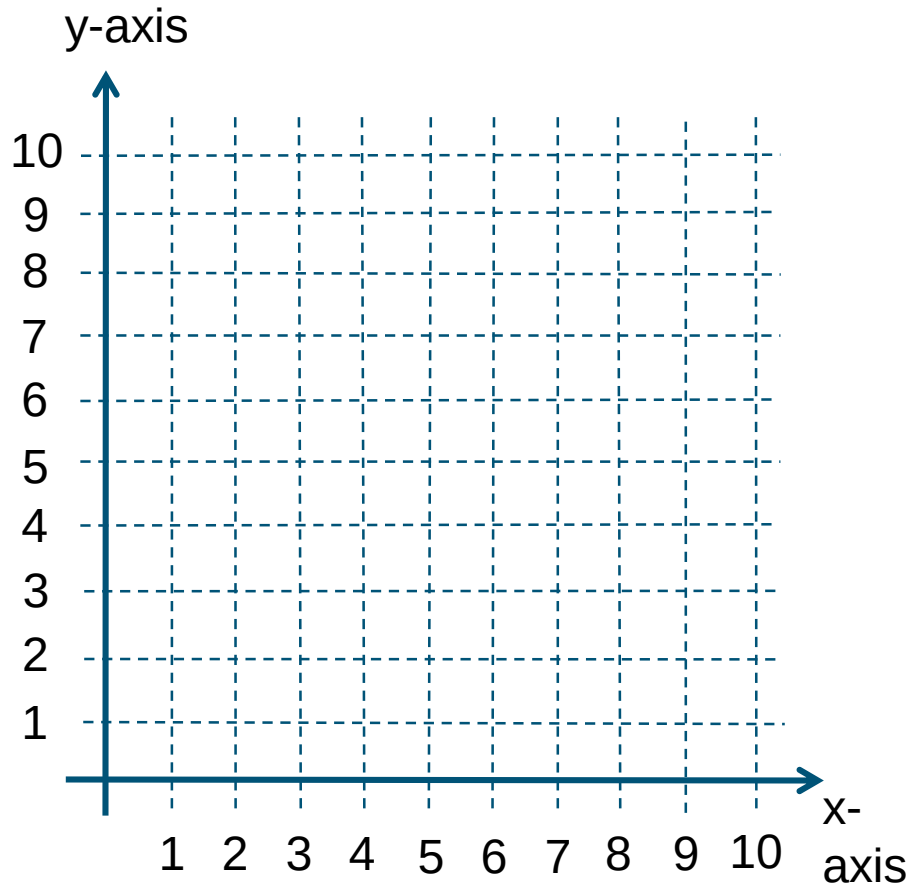
Lesson 5: Coordinates and Shapes

Let's examine these shapes with vertical or horizontal symmetry to the x- or y-axis.

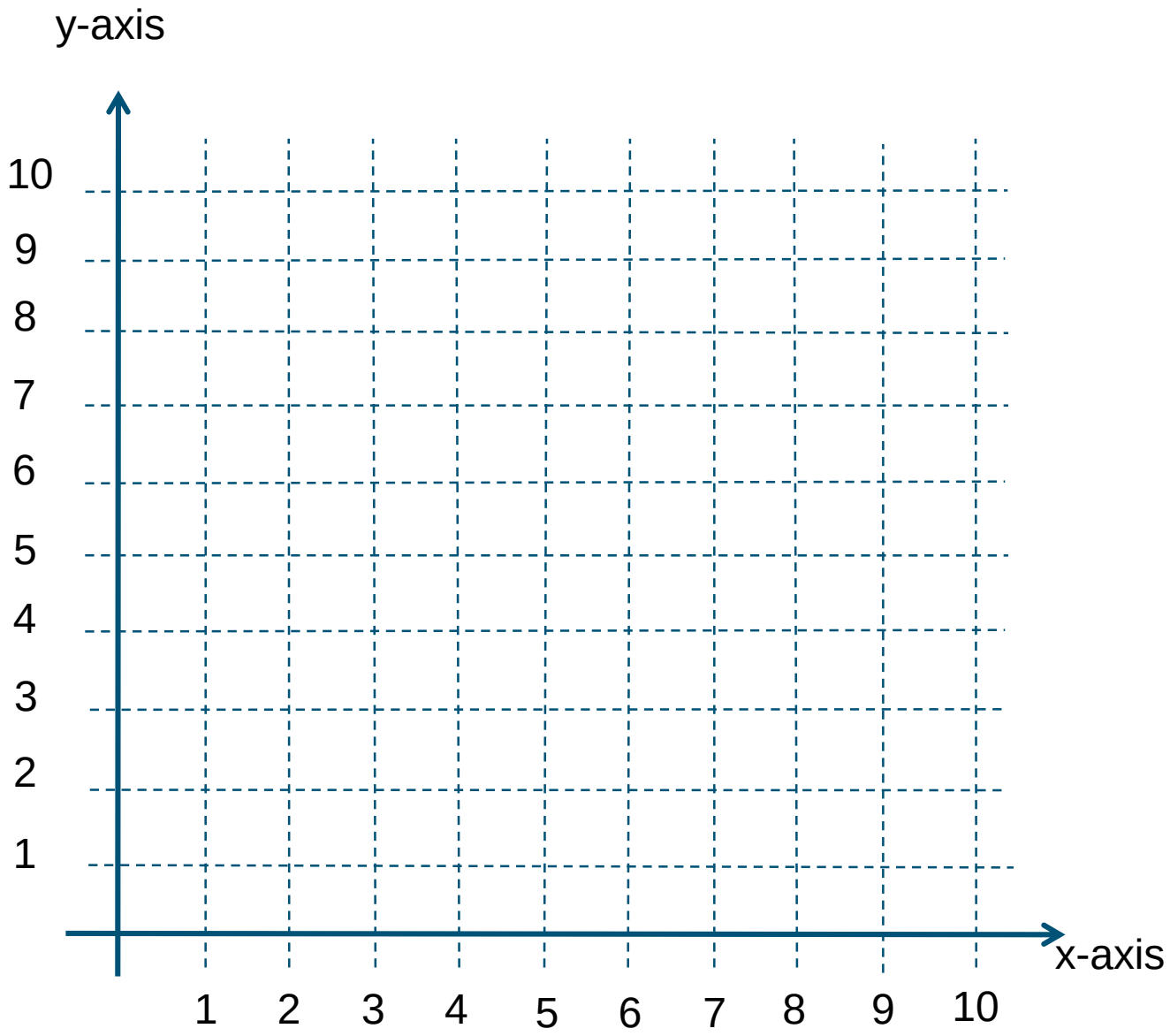
9. What is the pattern with x- and y-coordinates for a rectangle?

10. What is the pattern with x- and y-coordinates for a rhombus?

11. What is the pattern with x- and y-coordinates for a trapezoid?



Template 5.1



Lesson 5: Review and Takeaways

12. What is something mathematically that you will remember from this lesson?

13. When graphing the following shapes, what coordinates stay the same and which ones change?

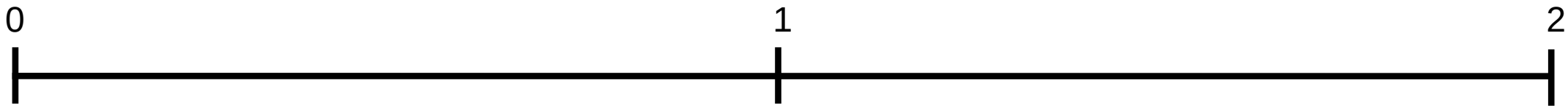
a. Square
b. Rectangle
c. Rhombus
d. Parallelogram

Warmup: Number Line Quick Draws

Complete the following Quick Draws using number lines before starting the next lesson.

Let's practice using number lines to represent fractions.

Copy the drawing of the number line below that shows the length of 0 to 2.



Every time you are shown the ***denominator***, ***partition*** the number line into that number of units. These will be the ***unit fractions*** we will ***iterate***.

Warmup: Number Line Quick Draws

$\frac{3}{5}$ $\frac{4}{5}$ $\frac{2}{5}$ $\frac{9}{5}$

Lesson 6

SHAPE ART USING COORDINATES

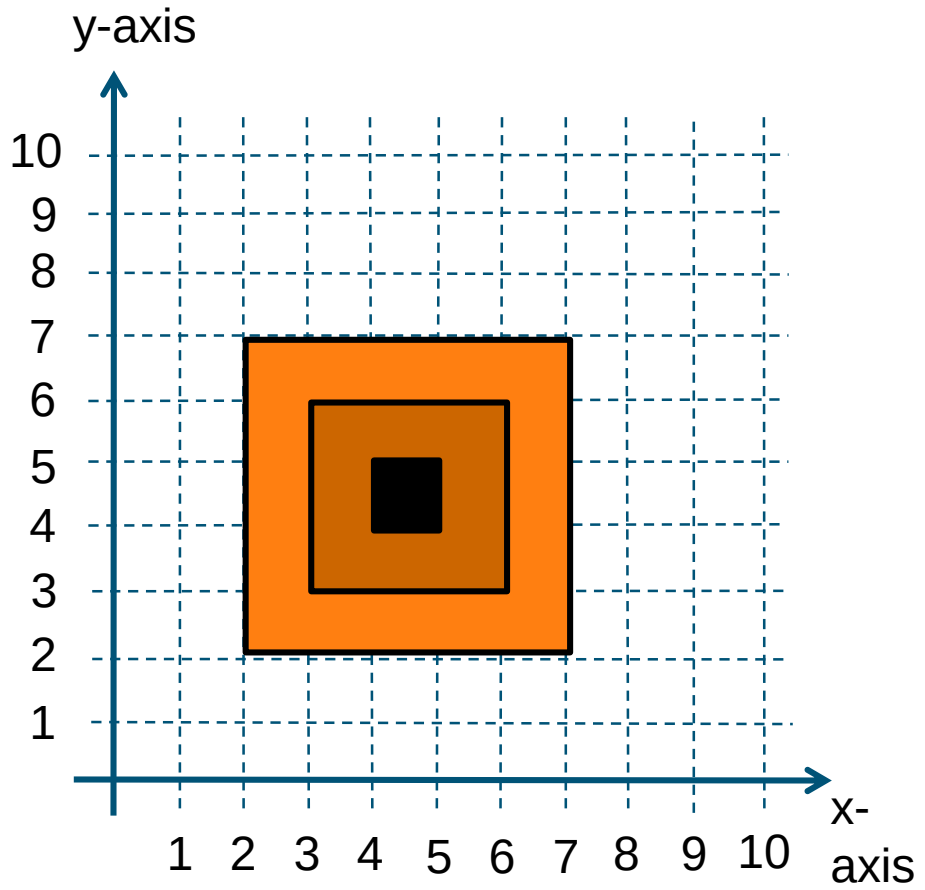
Lesson 6: Shape Art Using Coordinates

Shapes are used in designing buildings, logos and art. These are just a few areas where shape art is found. We are going to examine different types of art, and we will use the coordinate graph to help us describe and create different art.

Here is an example.

1. Anna says there is a pattern with the coordinates. What do you think her patterns are? Describe a few.

2. Daren said that once you know the coordinates of the first square, you can determine the others by subtracting 1 from each of the values. Explain whether his idea works?



Lesson 6: Shape Art Using Coordinates

Take notes in your journal on the following.

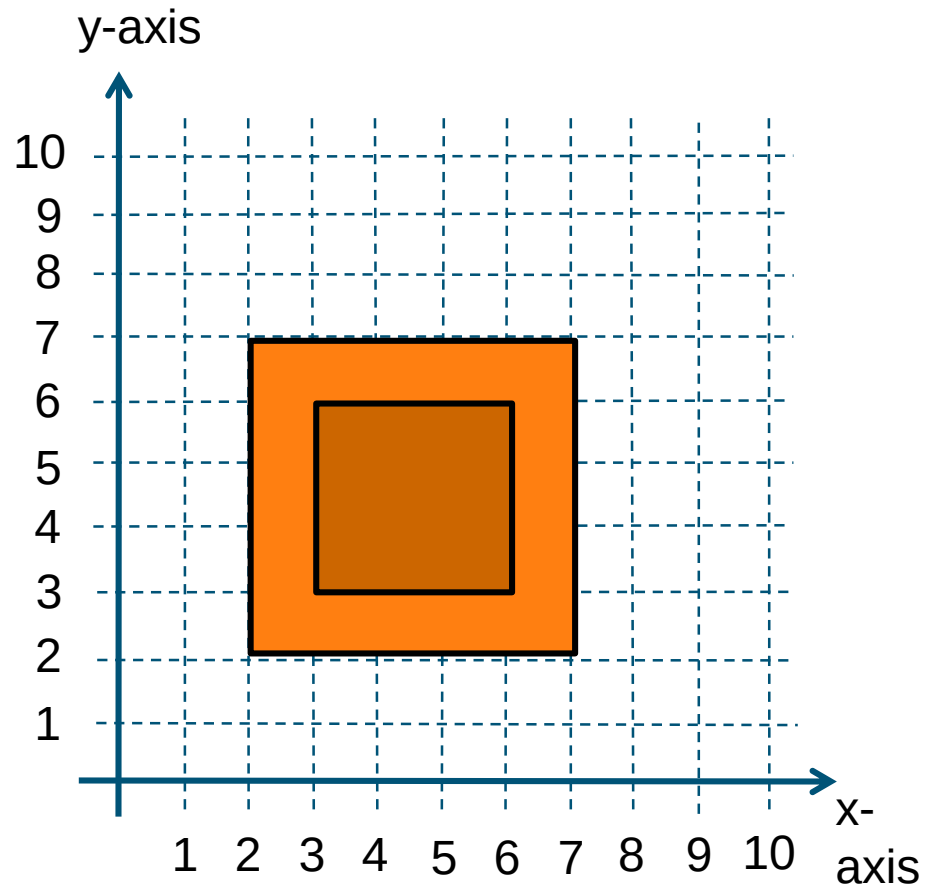
The first square has the following coordinates:

(2, 2), (2, 7), (7, 7), (7, 2)

The coordinates of a square have a unique pattern where the x-coordinate is either 2 or 7 and the y-coordinate is either 2 or 7. There are four different ways to arrange the 2's and 7's.

The next inner square has the following coordinates:

(3, 3), (3, 6), (6, 6), (6, 3)



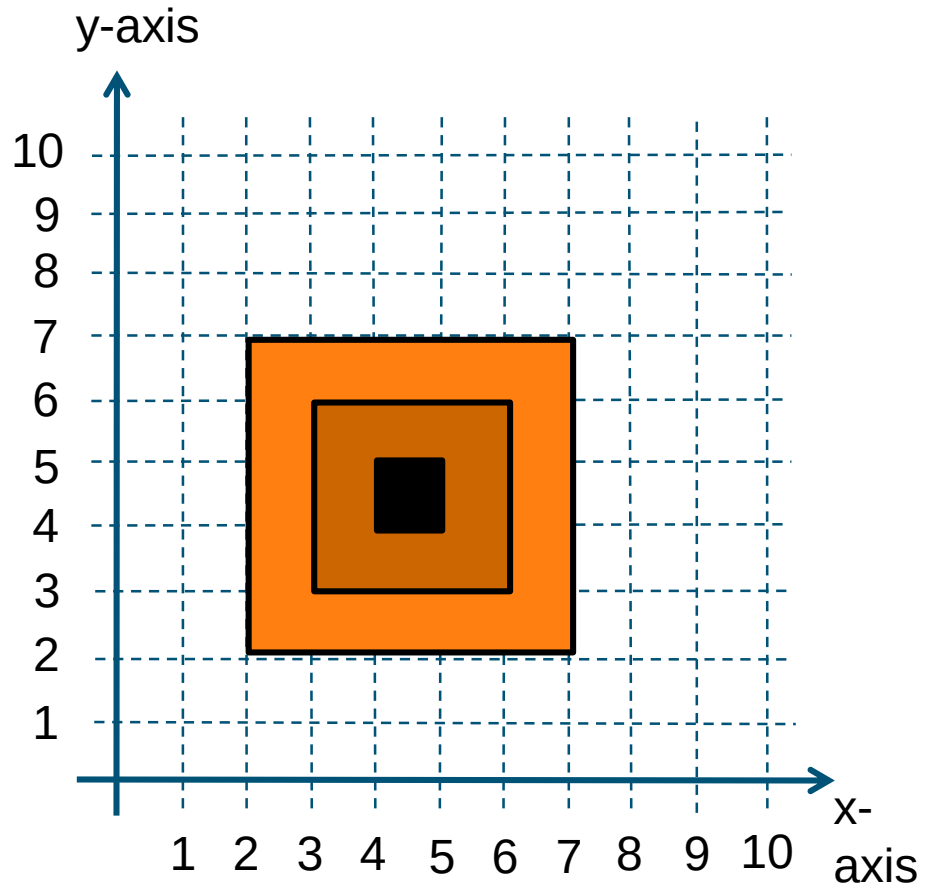
Lesson 6: Shape Art Using Coordinates

Middle square: (3, 3), (3, 6), (6, 6), (6, 3)

So, Dexter's idea is almost right. The square is smaller, but the smaller value is increased by one and the larger value is decreased by one. Let's try this idea for the smallest square: 3 + 1 is 4 and 6 – 1 is 5.

This means the coordinates for the most inner square should be (4, 4), (4, 5), (5, 5), (5, 4) . . .

3. Does Dexter's idea work? Is it correct?

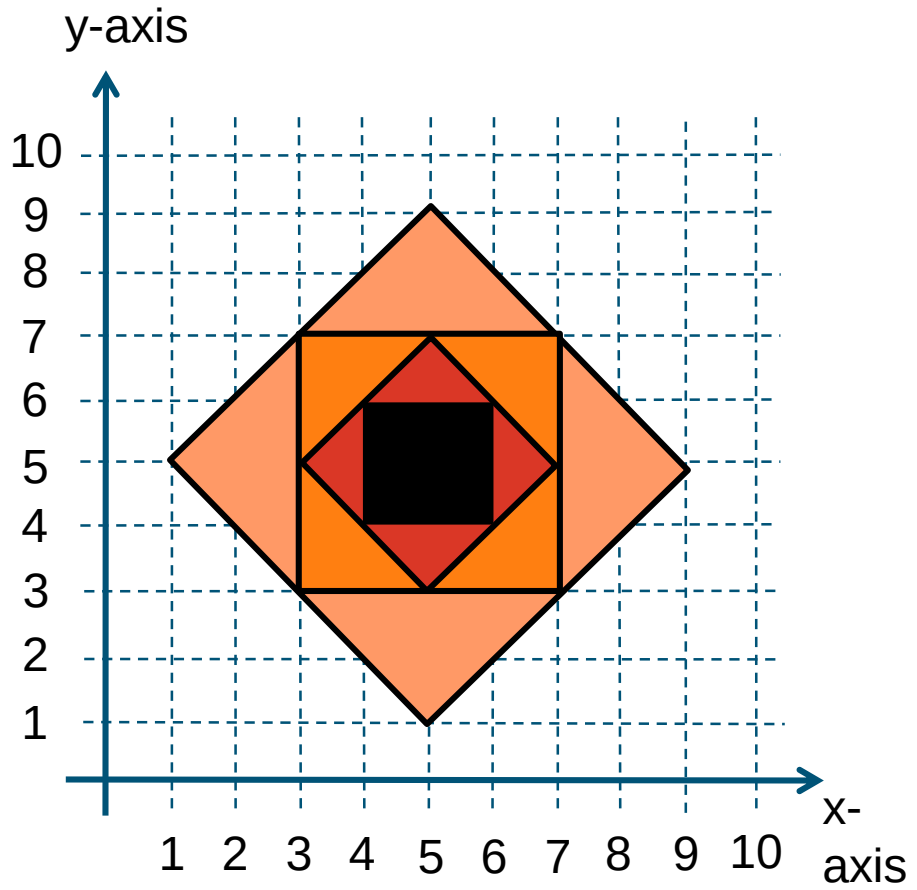


Lesson 6: Shape Art Using Coordinates

4. List the coordinates of each of the three squares.

5. Going from the largest square to the smallest square, determine whether Dexter's new modified conjecture still works on this new pattern. If not, what is the pattern?

6. Here, we created a larger square that is rotated. Explain how you can use the coordinates of another square to determine the coordinates of this new square.



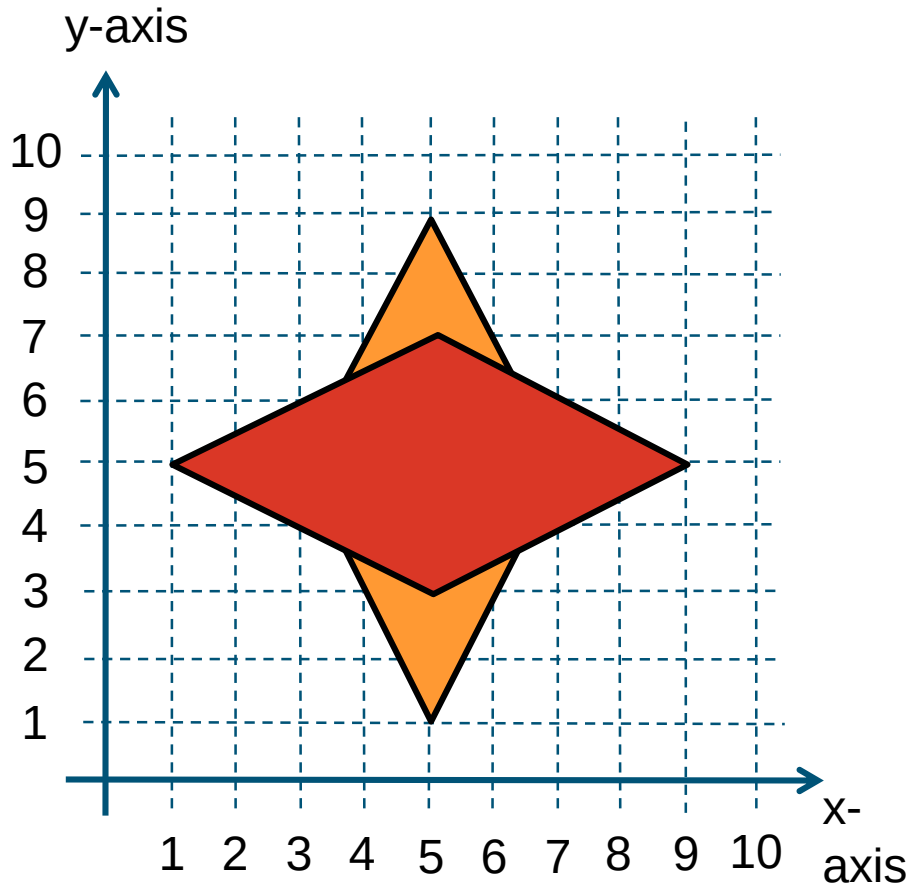
Lesson 6: Shape Art Using Coordinates

7. To the right is a rhombus. What are the coordinates?

8. What is the relationship among the four coordinates?

9. Now, make a copy of the rhombus and rotate it 90 degrees clockwise around its center. What do you think the coordinates are?

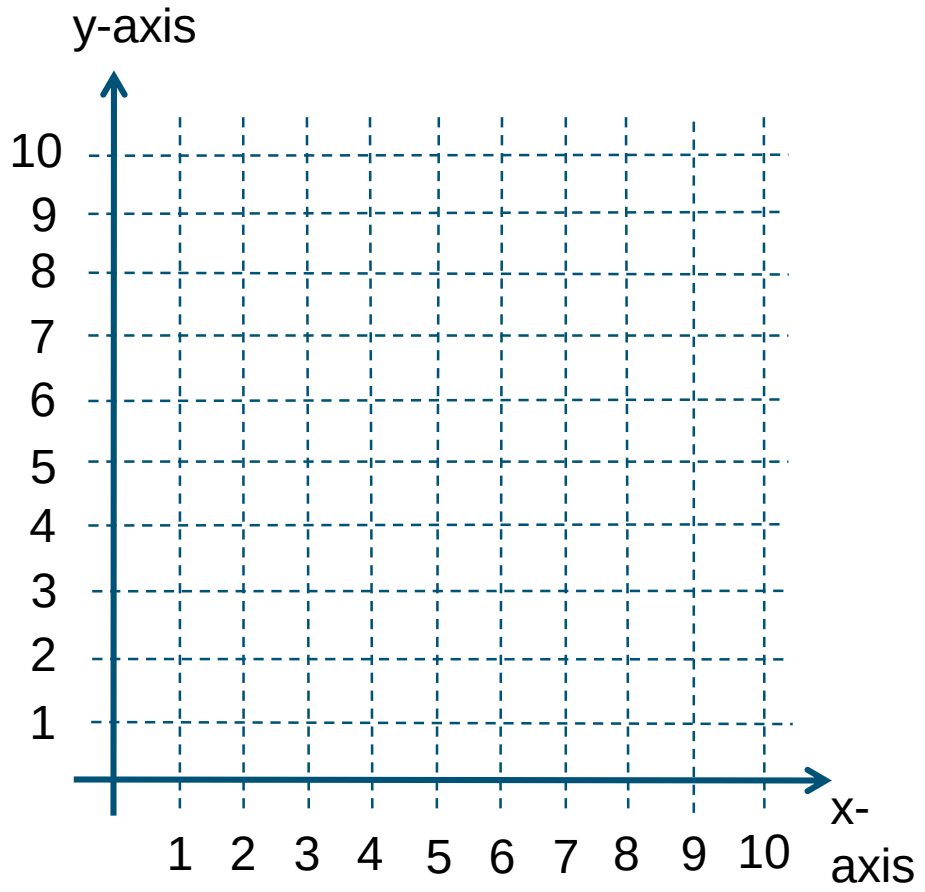
10. Draw this new shape.



Lesson 6: Shape Art Using Coordinates

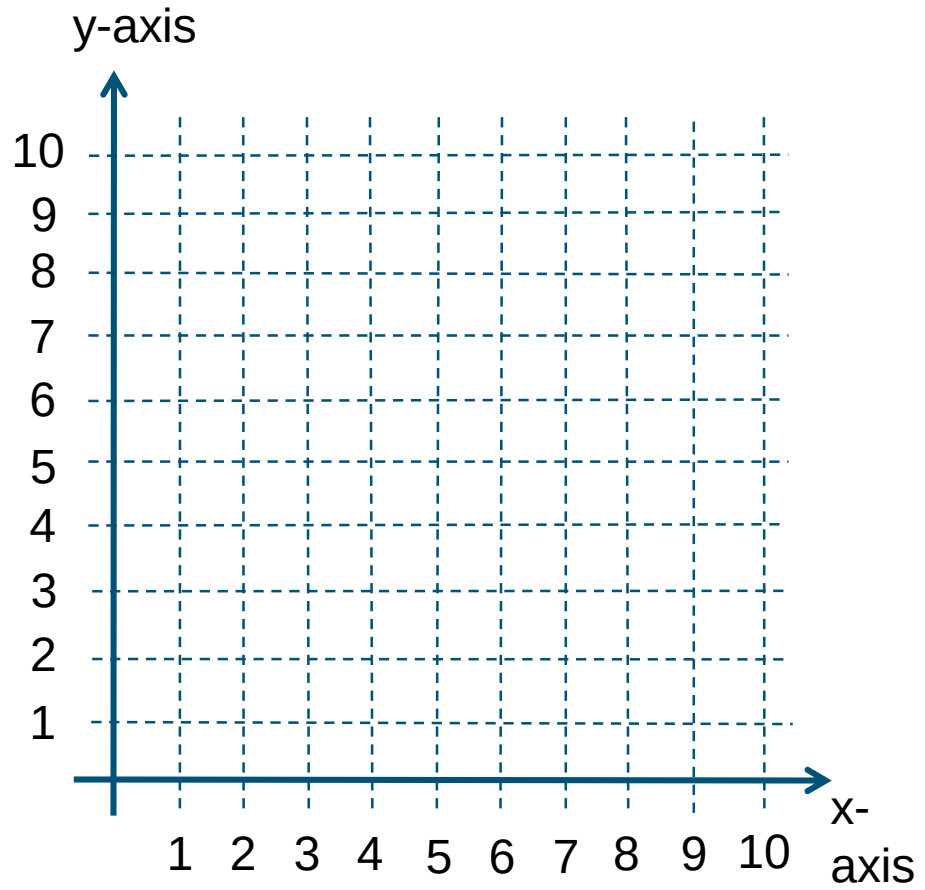
11. You are going to be given one coordinate at a time. Given each new coordinate, describe where on the coordinate plane the next point will be. For example, if we start at (0, 0) and then the next point is (0, 2), we have moved two units up. Graph each point and connect them with a straight line.

Question	Point	Next Point	Direction	Distance
a.	(5, 5)	(6, 5)		



Lesson 6: Shape Art Using Coordinates

Question	Point	Next Point	Direction	Distance
a.	(5, 5)	(6, 5)		
b.	(6, 5)	(6, 7)		
c.	(6, 7)	(3, 7)		
d.	(3, 7)	(3, 4)		
e.	(3, 4)	(8, 4)		
f.	(8, 4)	(8, 9)		
g.	(8, 9)	(1, 9)		
h.	(1, 9)	(1, 1)		
i.	(1, 1)	(10, 1)		

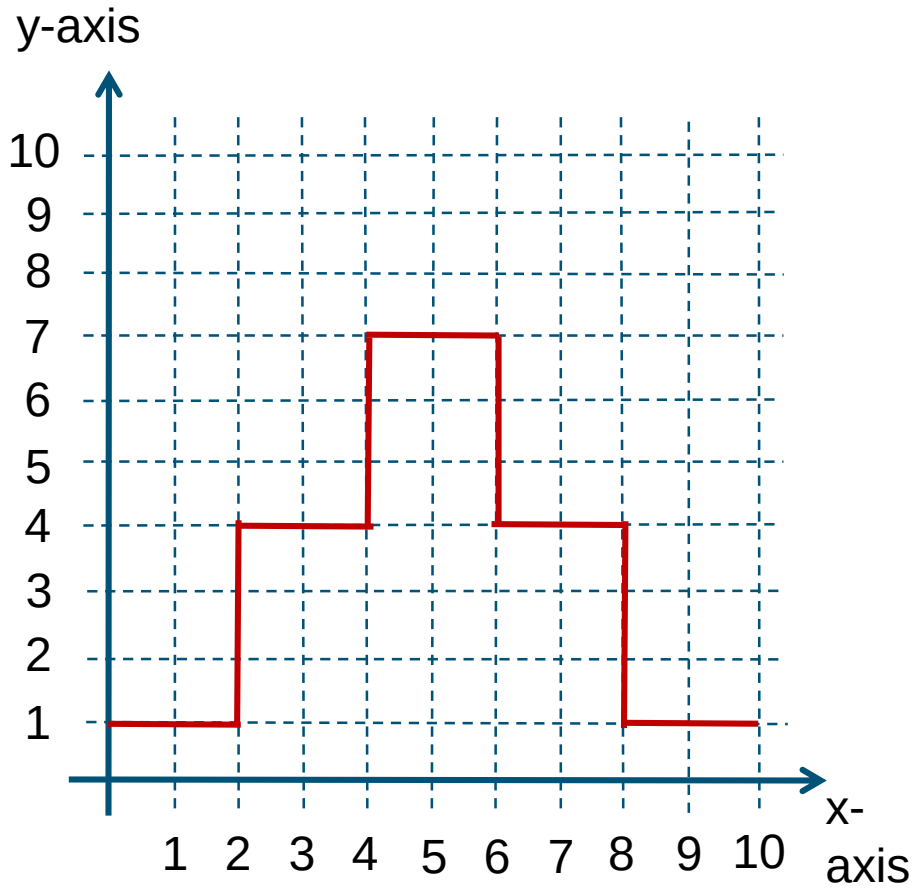


12. Describe the shape you created.

Lesson 6: Shape Art Using Coordinates

13. Use the shape to complete the table.

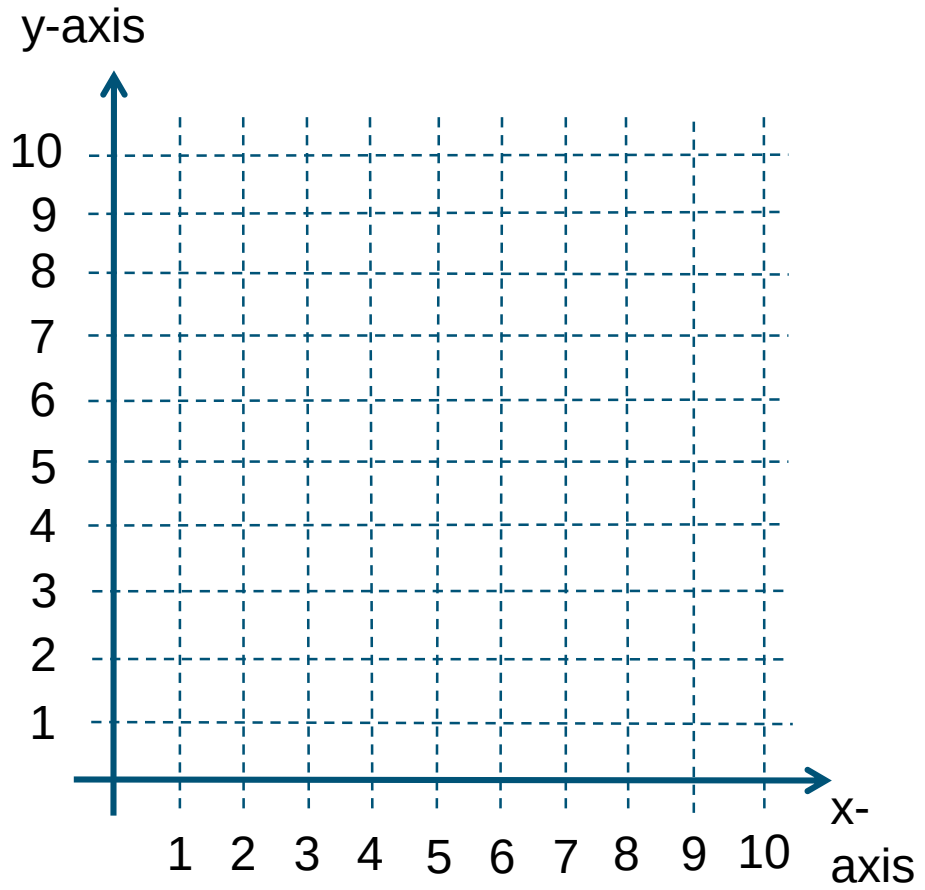
Question	Point	Next Point	Direction	Distance
a.				
b.				
c.				
d.				
e.				
f.				
g.				
h.				
i.				
j.				



Lesson 6: Shape Art Using Coordinates

14. Use the direction and distance to create the shape and complete the table.

Question	Point	Next Point	Direction	Distance
a.	(7, 8)		Down	5
b.			Left	5
c.			Up	4
d.			Right	4
e.			Down	3
f.			Left	3
g.			Up	4
h.			Right	4

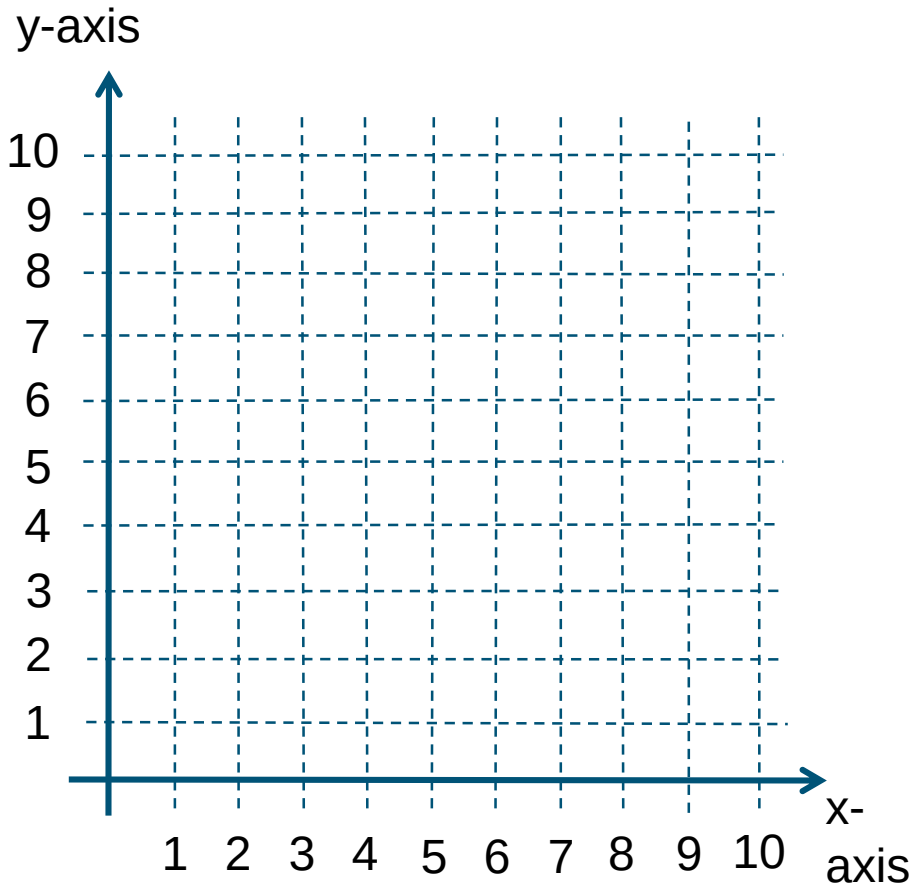


Lesson 6: Shape Art Using Coordinates

15. Now create your own shape or design and write down all of the coordinates of any intersections or vertices.

Trade your coordinates with a partner and try to recreate the figure by plotting all of the given coordinates.

Question	Point	Next Point	Direction	Distance
a.				
b.				
c.				
d.				
e.				



Lesson 6: Review and Takeaways

16. What patterns did you notice with the different ‘shape art’ we created with coordinate graphs.

17. What important math ideas did you get out of this lesson?

18. What did you notice with the x- and y-coordinates when you graph a vertical or horizontal line?

Warmup

Everyone standup and find a little bit of room to move.

We are going to walk to using coordinates. Each step is 1 unit and should be the same going forward, backward, right or left. Your starting point is the origin.

Start at (0, 0)
Walk to (0, 1)
Walk to (2, 1)
Walk to (2, 3)
Walk to (3, 3)
Walk to (3, 0)
Walk to (0, 0)

What shape did we make?

Start at (0, 0)
Walk to (2, 2)
Walk to (4, 2)
Walk to (6, 0)
Walk to (0, 0)

What shape did we make?

Lesson 7

PATTERNS: VARIED PRACTICE

Lesson 7: Patterns

We have been working with different coordinates on the coordinate plane. Now we are going to look at coordinates that have patterns, and we will use a table to keep track of them.

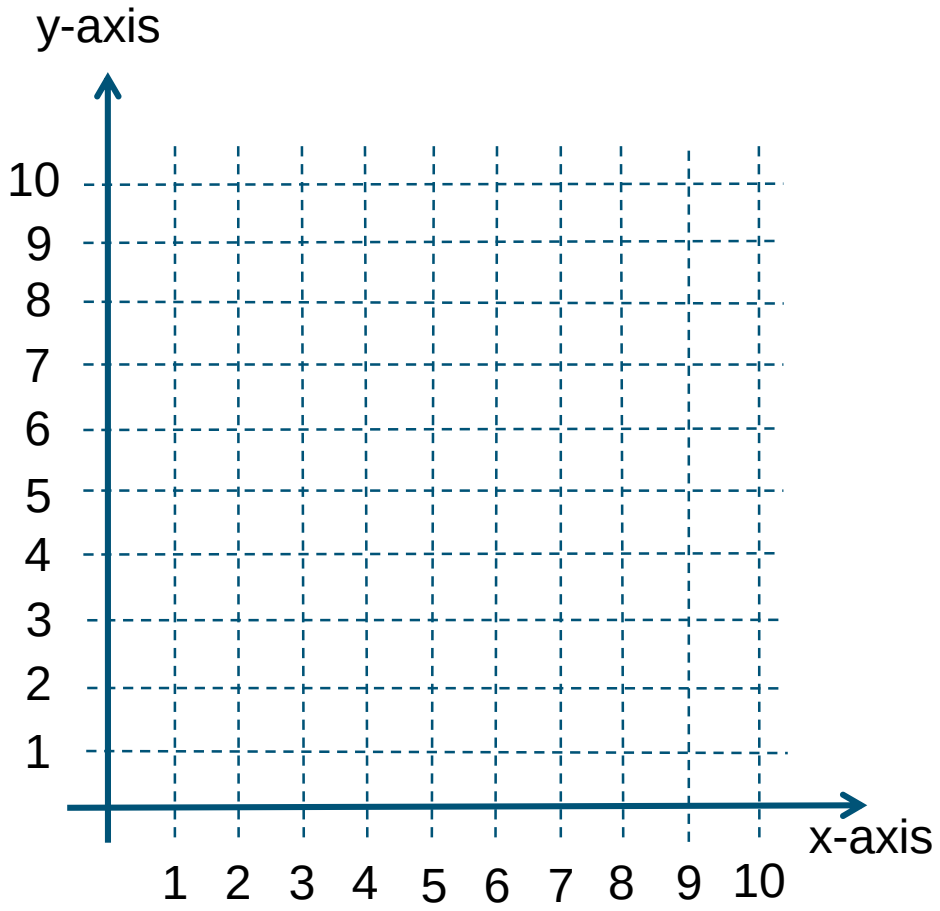
Here is a table of coordinates.

X	Y
0	0
2	3
4	6

1. Graph each of the points.

2. Use a rule to describe the x-coordinates.

3. What is a rule to describe the y-coordinates?



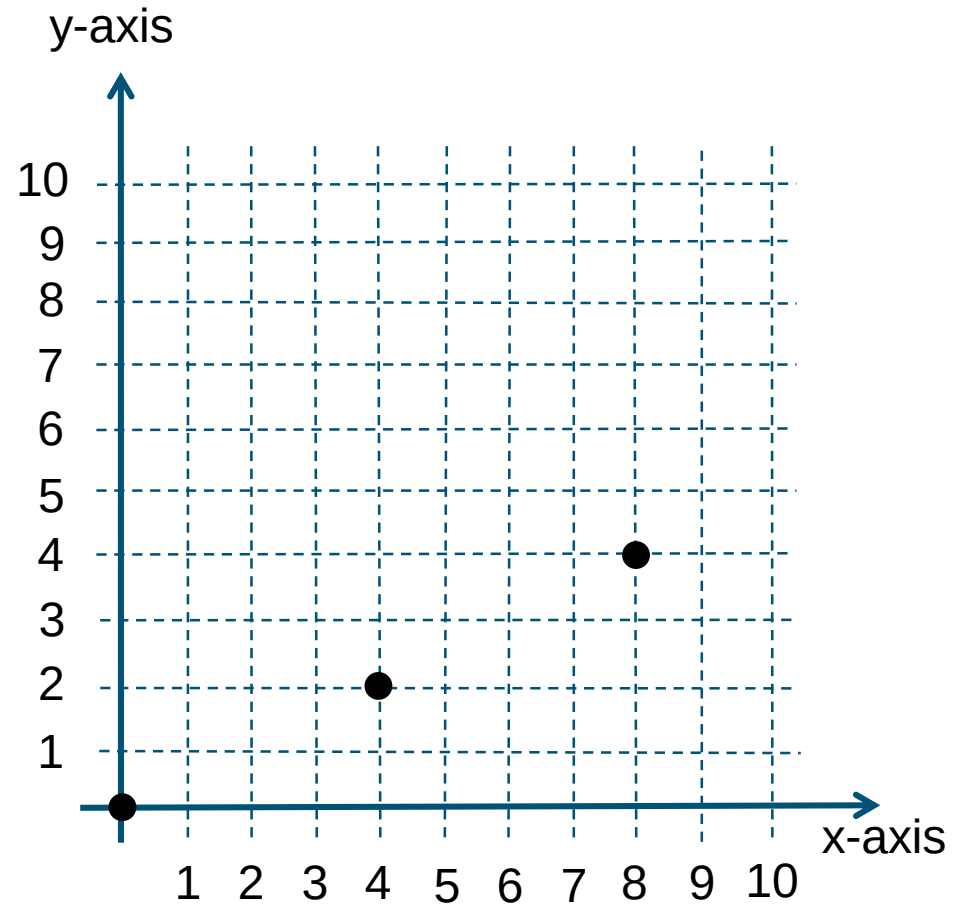
Lesson 7: Patterns

4. Complete the table based on the points on the graph.

5. What is the rule for the x-coordinates and what is the rule for the y-coordinates?

6. If these patterns continued, what would be the next coordinate pair?

X	Y



Lesson 7: Patterns

Marcella came up with a pattern. She says the y-coordinate is always 3 times larger than the x-coordinate.

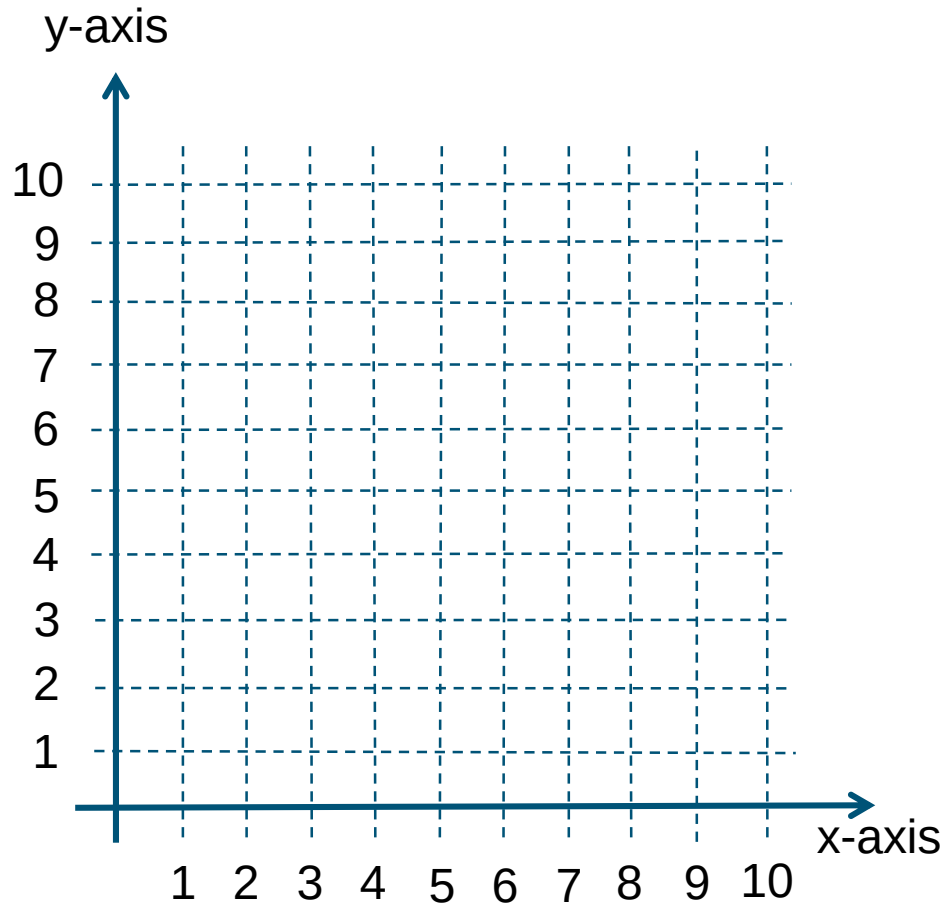
7. What do you think the coordinates are? (Use the table.)

8. Graph the points.

9. What is the change in the x values?

10. What is the change in the y values?

X	Y



Lesson 7: Patterns

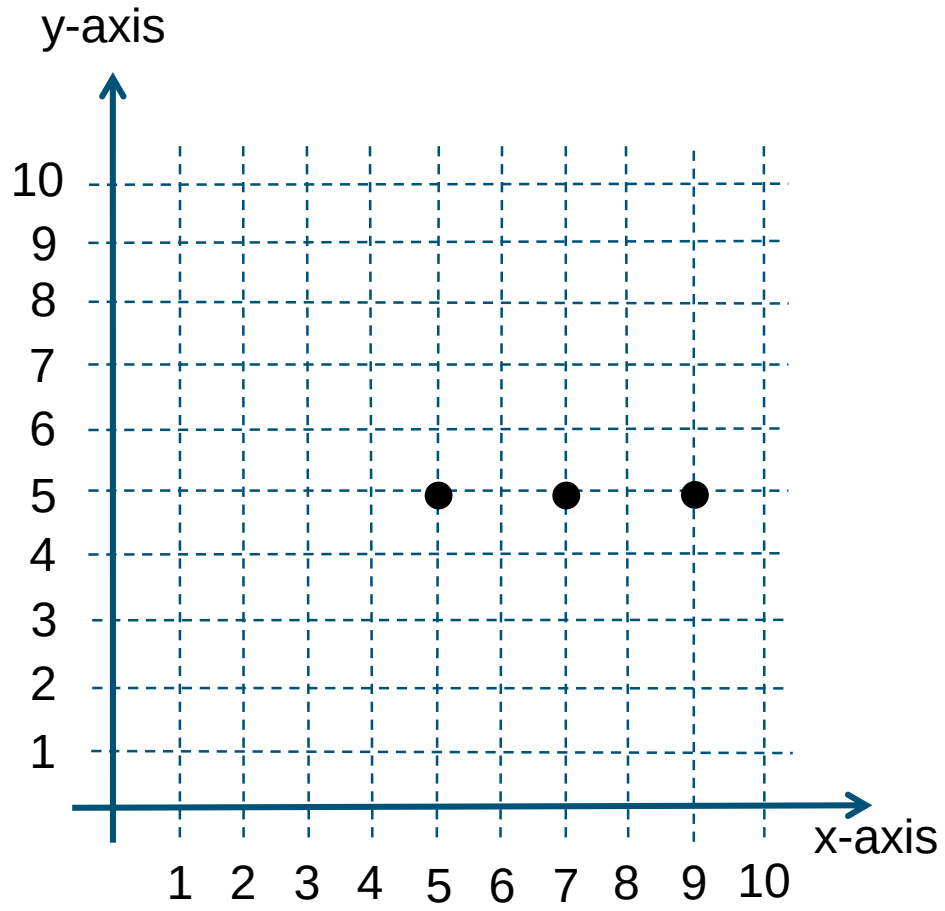
Marcella graphed another pattern.

11. Write the coordinates in the table.

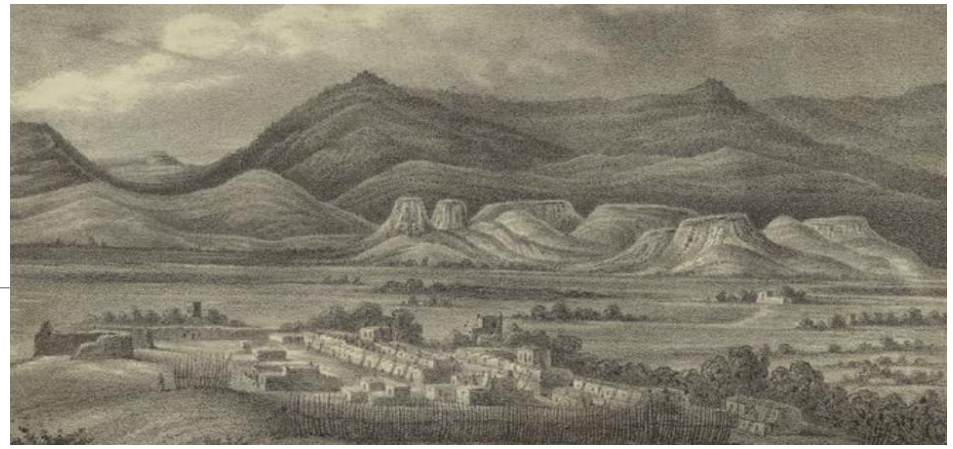
12. Describe the rule for generating the x- and y-coordinates.

13. Name another coordinate pair that matches the rule.

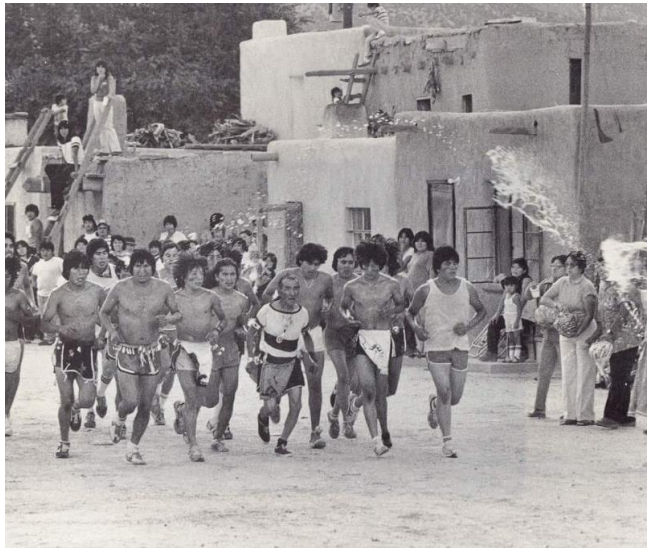
X	Y



Lesson 7: Patterns



Running has been an important part of the lives of the Jemez people for centuries.
Because Pueblo of Jemez is at 5,600 feet of elevation, runners training by running through the hills and mountains in Jemez are better able to use oxygen to fuel their bodies to run long distances at a fast pace.
Steve Gachupin, from Pueblo of Jemez, won the daunting and difficult Pikes Peak Marathon 6 times. That is more than any other human ever has. The Pikes Peak race has more than 14,000 feet of changes in elevation and takes 4 hours for even the best runners to finish.



Lesson 7: Patterns

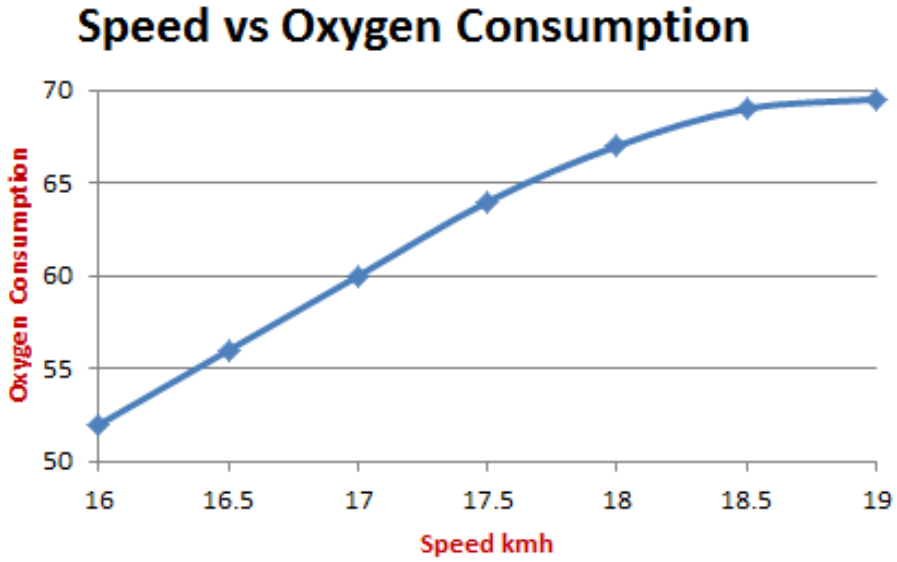
The graph to the right is a way the coordinate plane can be modified to show the relationship between two changing measurements.

In this example, the x-axis shows the speed of a runner in kilometers per hour.

The y-axis shows the amount of oxygen used as the runner's speed increases.

14. What do you notice about the graph?

15. What statements can you make about the relationship between running speed and oxygen consumption?



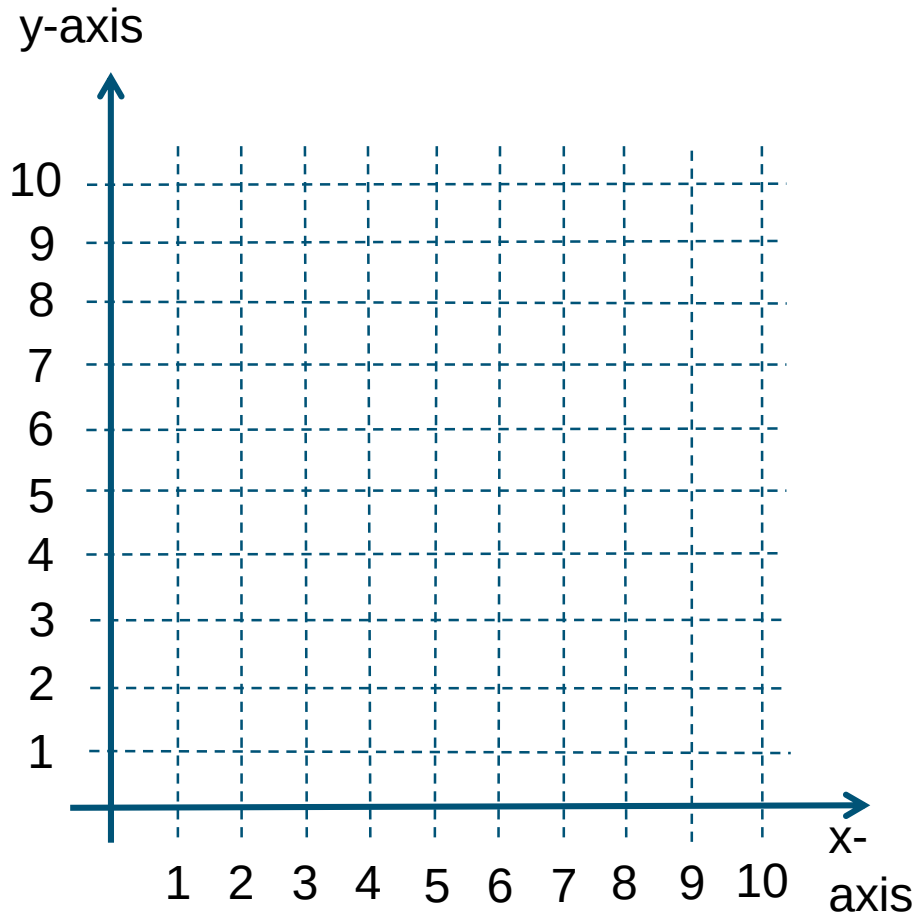
Lesson 7: Review and Takeaways

16. What patterns do you notice in the coordinates listed?

17. Graph the points from the table.

18. Describe what the graph tells you if the x-axis is hours and the y-axis is inches of rainfall during those hours.

X	Y
1	2
2	4
3	6
4	8
5	5
6	4



Warmup

Count from 0 to 2 and back down by $\frac{1}{4}$'s .

Now count each month by a fraction of 1 year (0 to 1 by $\frac{1}{4}$ units and back to 0)

$$\frac{0}{4} \quad \frac{1}{4} \quad \frac{2}{4} \quad \frac{3}{4} \quad \frac{4}{4} \quad \frac{5}{4} \quad \frac{6}{4} \quad \frac{7}{4} \quad \frac{8}{4}$$

Now count by converting to simplified equivalent fractions. (From 0 to 2 to 0)

$$\frac{0}{4} \quad \frac{1}{4} \quad \frac{1}{2} \quad \frac{3}{4} \quad 1 \quad 1\frac{1}{4} \quad 1\frac{1}{2} \quad 1\frac{3}{4} \quad 2$$

Lesson 8

GRAPHING FRACTIONS ON A LINE PLOT

Lesson 8: Graphing Fractions on a Line Plot

We have actually used a type of graph that is similar to the coordinate graph called a line plot.

You will be shown a line plot graphing the length measurements of objects around the room. The measurements are to the nearest quarter inch.

Answer the questions about the graph.

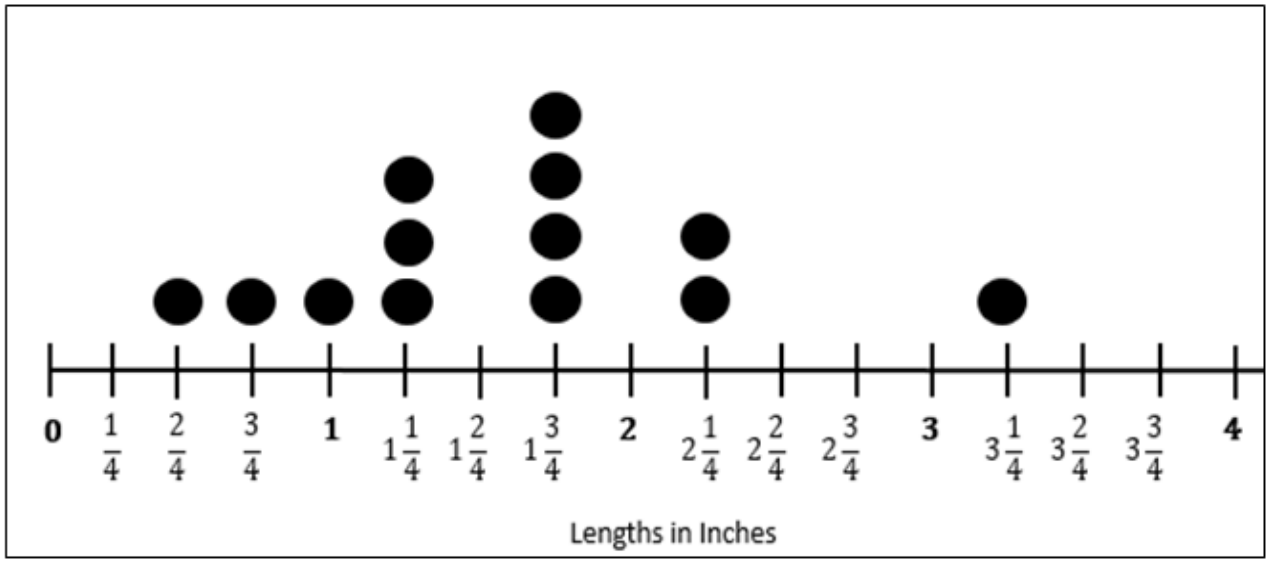
Lesson 8: Graphing Fractions on a Line Plot

1. What is the difference between the shortest and longest measurement found in the graph?

2. If you added up the 3 shortest lengths you found together, what would that total length be?

3. If you added the length of shortest and longest object, what would that sum be?

4. Use multiplication to find the total length of the 4 objects that measured 1 ¾ inches.



Lesson 8: Graphing Fractions on a Line Plot

5. Some students say they found more objects measuring $1\frac{1}{4}$ than any other length. Why did they think this and why are they incorrect?

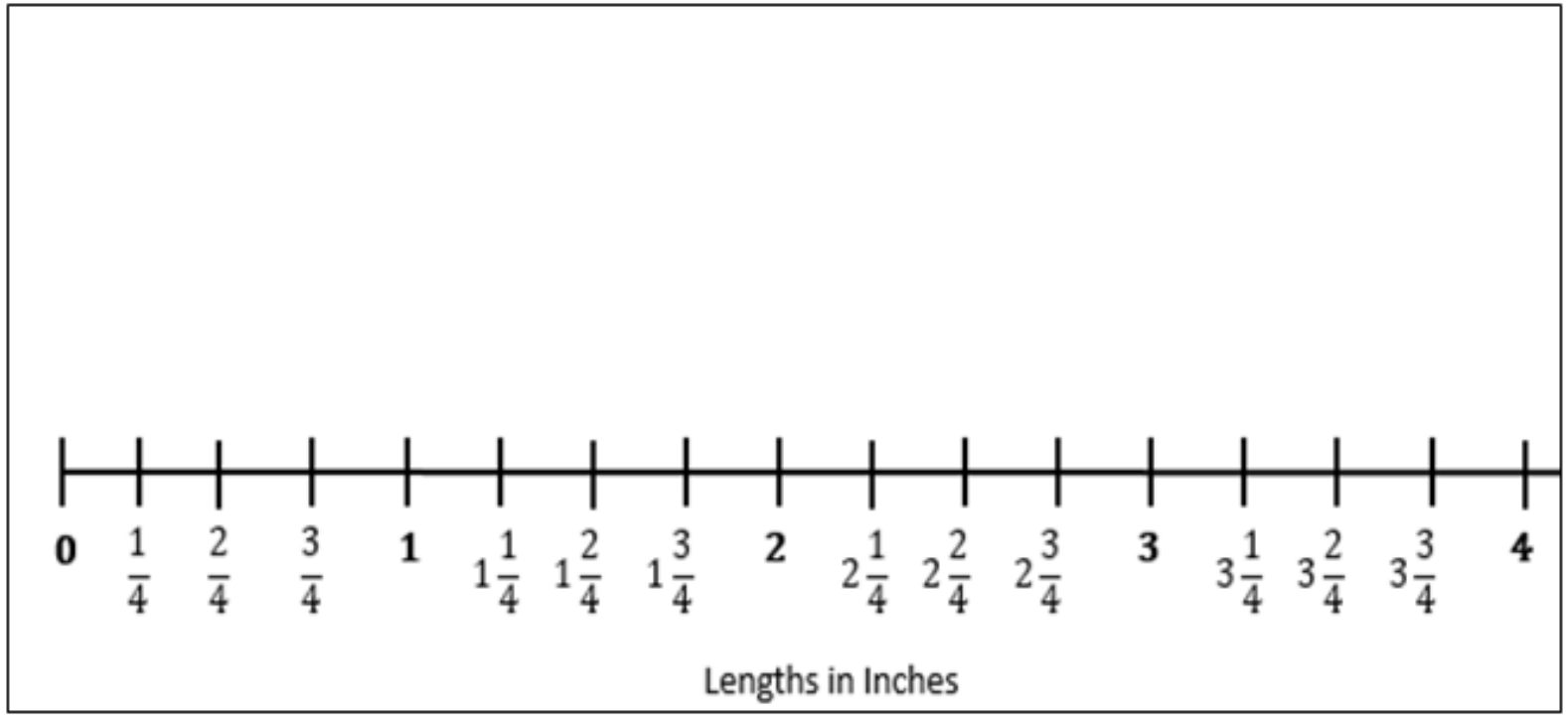
6. One student says that if you add up all of the objects with a length of $1\frac{3}{4}$ inches the total length would be $4\frac{12}{16}$ inches. How did the student come to this incorrect answer? What is the correct sum?

5. Some students say they found more objects measuring $1\frac{1}{4}$ than any other length. Why did they think this and why are they incorrect?

6. One student says that if you add up all of the objects with a length of $1\frac{3}{4}$ inches the total length would be $4\frac{12}{16}$ inches. How did the student come to this incorrect answer? What is the correct sum?

Lesson 8: Graphing Fractions on a Line Plot

Now it's your turn to collect measurements and graph them.
7. Think of classroom supplies to lengths that are within the range shown on the graph.
8. Collect measurements of at least 12 of these classroom supplies.
9. Write 3 questions you could ask someone to answer if they were presented with your graph.



Lesson 9

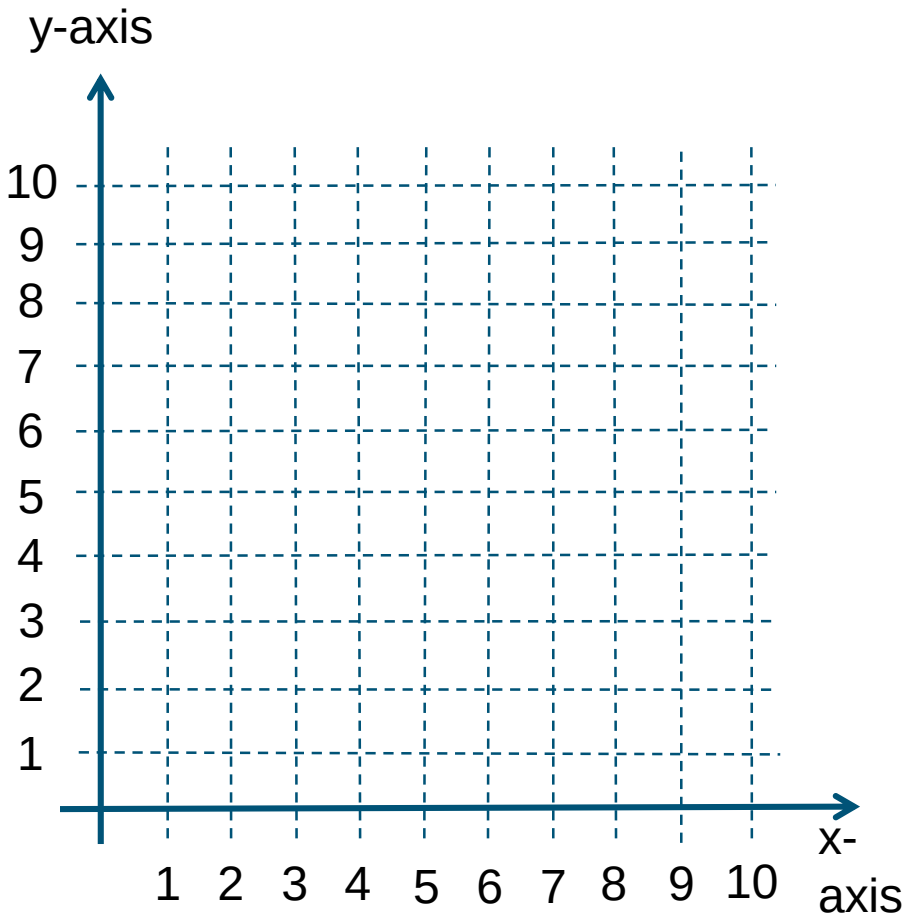
REVIEW

Lesson 9: Review

Word Bank	
Parallel	Coordinate
	Axis
Perpendicular	
	Origin

Use the word bank to help answer the following.

1. Define the origin and label this point on the graph to the right.
2. What is a coordinate plane, and in what situations would you use it?
3. Maya is wondering what the difference is between the points (3, 4) and (4, 3). She says they both have a distance of 3 and 4 and therefore are really the same. Explain whether her comment is correct.
4. Without graphing, what do you think is the coordinate of the point half way between each of these given coordinates?
   a. (2, 1) and (6, 1)
   b. (5, 3) and (5, 9)
   c. (2, 2) and (8, 8)



Word Bank

Parallel
Coordinate
Axis
Perpendicular
Origin

Lesson 9: Review

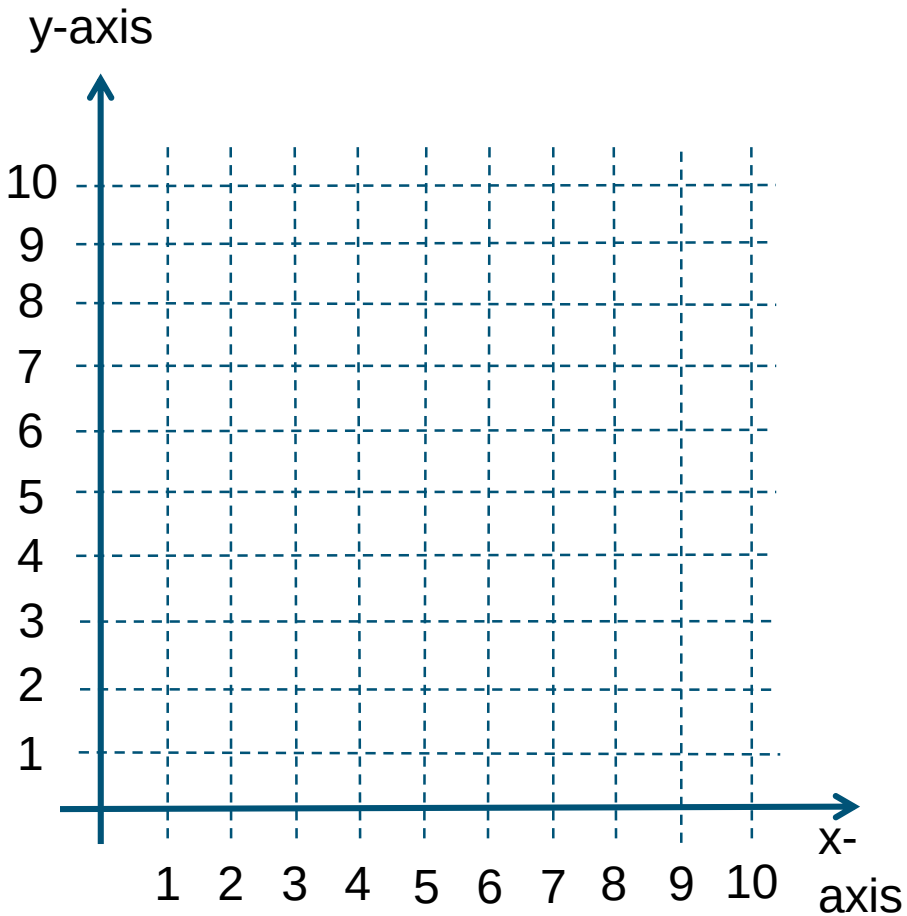
5. Find a shape that you can draw on the coordinate plane using straight lines. Draw the shape and list its coordinates.

6. Then, change the x-axis coordinates by adding 1 to each.

7. Re-draw the shape in its new location. This is called a ***translation*** (or slide).

8. Draw a different translation by changing the y-axis coordinates?

9. From this entire module, what are 3 takeaways or 3 math ideas you want to remember to use in the future?



DMT INSTITUTE

"The Developing Mathematical Thinking Institute (DMTI) is dedicated to enhancing students' learning of mathematics by supporting educators in the implementation of research-based instructional strategies through high-quality professional development, curricular resources and assessments."

For more information contact
Dr. Brendefur at **jonathan@dmtinstitute.com**