Grade Level/Course: Grades 3 – 5

Lesson/Unit Plan Name: Line Plots Through the Grades

Rationale/Lesson Abstract: Students will explore constructing and interpreting line plots with whole number and fractional scales. Students will then use data from line plots to solve one-step and multi-step problems building on previously learned strategies for adding, subtracting, multiplying, and dividing fractions.

Timeframe: 60 minutes

Common Core Standard(s):

3.MD.4: Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters.

4.MD.4: Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots. *For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.*

5.MD.2: Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots. *For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.*

Instructional Resources/Materials:

- **grid paper (optional)**
- **pencil**
- **math journals**
- **ruler**
- **string**

Activity/Lesson:

Focus Question: How do we make and use line plots to represent data and solve problems?

How many siblings do you have?
Create a tally chart representing the number of siblings.

Are there any other ways to represent this data?
[bar graphs, picture graphs]

Tell the students that today they will learn about another way to represent data. Introduce the line plot by showing a number line.

*Like a bar graph and picture graph, a line plot has an **x-axis**. It looks like a number line.*

Explain that the numbers on the number line are the labels for data. Explain that the graph will show the **frequency**, or how often, a number appears.

*Each tally or person with a sibling is represented with an **x**. Each **x** represents exactly one person. How many x's would go with 0? [2] with 1? [3]*

Continue plotting the frequency of each number. Then together remind students that all graphs need a title. Come up with an appropriate title together.

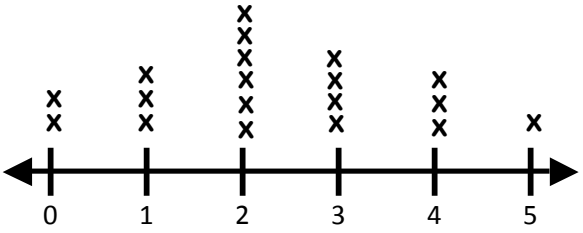
Ask questions about the data on the graph such as:

- What is the **range** of the graph, from what number to what number does our graph go to? [0 – 5]
- How many students have more than three siblings? [4]
- How many students have less than three siblings? [11]
- What is the most common number of siblings? [2]
- What is the least common number of siblings? [5]

Sample Data & Line Plot

#siblings	#students
0	
1	
2	
3	
4	
5	

Number of Siblings

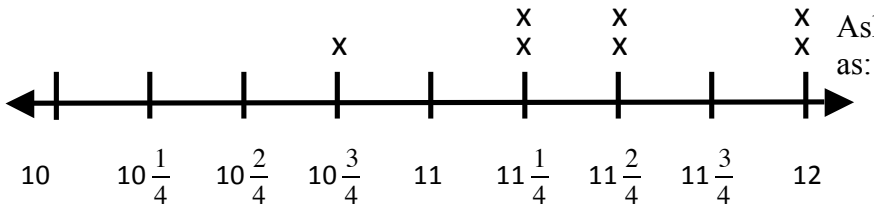


Sample Data & Line Plot

student	length of string (in)
group 1	12 inches
group 2	$11\frac{1}{4}$ inches
group 3	$11\frac{2}{4}$ inches
group 4	$10\frac{3}{4}$ inches
group 5	$11\frac{2}{4}$ inches
group 6	12 inches
group 7	$11\frac{1}{4}$ inches

Ordered Data

~~$10\frac{3}{4}$~~ ; ~~$11\frac{1}{4}$~~; ~~$11\frac{1}{4}$~~ ; ~~$11\frac{2}{4}$~~ ; ~~$11\frac{2}{4}$~~; ~~12~~ ; ~~12~~



Length of String (inches)

Have students work in pairs, table groups, or as a class. Give each pair or group a piece of string (if working as a class, use at least 7 strings). Have them measure the string to the nearest quarter or half inch. Record the results in a table.

We are going to use this data to make a line plot. This table isn't like the siblings table, we don't know the frequency, or how often each measurement occurs. In order to help us understand our data, let's put our measurement in ascending order.

As a class, order the data.

What is the range of our data? What are the smallest and largest numbers? [$10\frac{3}{4}$ and 12]

Make an open number line from your smallest to largest number, if the data is fractional use the closest appropriate whole number.

Create the line plot, paying close attention to accuracy. As you plot the data, it is helpful to cross out as you go.

Ask questions about the data on the graph such as:

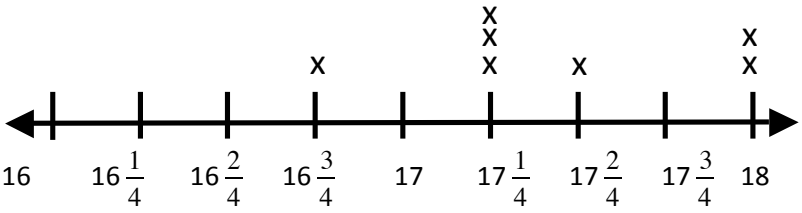
- What is the range of the graph, from what number to what number does our graph go to? [10 – 12]
- How many groups have a string that is more than eleven inches? [6]
- How many groups have a string that is less than eleven inches? [1]
- What is the most common length of string? [a tie between three numbers]

After students have mastered creating line plots with whole number and fractional scaling, begin utilizing line plots to represent data and to solve one-step and multi-step problems using strategies for adding and subtracting fractions. Identify **trends** (**clumps** and **holes)** in the data. Complete problems and provide evidence of mathematical thinking such as computations and visual representations.

EX. #1

Our class is decorating the room for a spring celebration. Some students have brought flowers from home to decorate the counter that runs along one wall. The counter is 130 inches long. If the flowers are lined up, will they cover the length of the counter?

student	length of flower (in)
Nikki	18 inches
Cameron	$17\frac{1}{4}$ inches
Joel	$17\frac{2}{4}$ inches
Rachel	$16\frac{3}{4}$ inches
Brandon	$17\frac{1}{4}$ inches
Julliana	18 inches
Ellen	$17\frac{1}{4}$ inches



Length of Flower (inches)

Ordering Data For Line Plot

$16\frac{3}{4}$; $17\frac{1}{4}$: $17\frac{1}{4}$; $17\frac{1}{4}$; $17\frac{2}{4}$; 18 ; 18

When solving problems, use line plots to visually represent data. Then complete the addition of fractions using one or more addition strategies. Finish by answering the question. If students need a challenge ask them to include the difference in lengths.

$= 16\frac{3}{4} + 17\frac{1}{4} + 17\frac{1}{4} + 17\frac{1}{4} + 17\frac{2}{4} + 18 + 18$

$= 16 + 17 + 17 + 17 + 17 + 18 + 18 + \frac{3}{4} + \frac{1}{4} + \frac{1}{4} + \frac{1}{4} + \frac{2}{4}$

$= 33 + 34 + 35 + 18 + \frac{4}{4} + \frac{4}{4}$

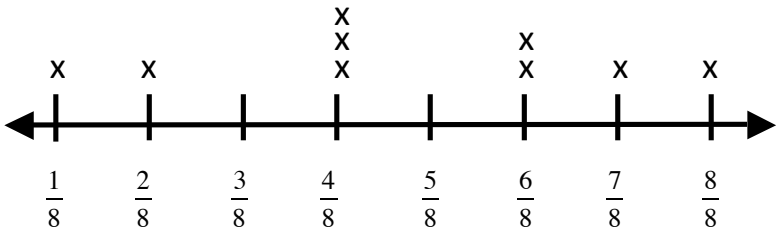
$= 102 + 20$

$=$ 122 inches

$\therefore$ No , the flowers will not cover the length of the counter because all together they measure 122 inches and the counter is 130 inches long.

EX. #2

Snow sticks to the ground when more than half an inch falls, and it takes at least 3 inches of snow for a good snowman. Did enough snow fall in the month of February to build a good snowman?



Snow in February (inches)

$$= \frac{6}{8} + \frac{6}{8} + \frac{7}{8} + \frac{8}{8}$$
$$= \frac{6+6+7+8}{8}$$
$$= \frac{27}{8}$$
$$= \boxed{3\frac{3}{8}}$$

When you complete this together as a class, discuss why you use only certain values and not all of them, students will often miss "more than half an inch."

When you complete the computation, vary your addition strategy to practice multiple methods.

∴ Yes, there was enough snowfall in February to build a good snowman because there was a total of $3\frac{3}{8}$ inches of snow on the ground and you only need 3 inches to build a snowman.

You Try!

A child wondered if they could have made a snowman in January. They found this data on the internet. Create a line plot for the data and determine if enough snow fell to make a good snowman.

Snow in January

$$\frac{1}{2}, \frac{1}{4}, \frac{1}{4}, \frac{4}{8}, \frac{3}{4}, \frac{1}{8}, \frac{2}{8}, \frac{3}{4}, \frac{2}{8}$$

Snow in January

$\frac{1}{2}, \frac{1}{4}, \frac{1}{4}, \frac{4}{8}, \frac{3}{4}, \frac{1}{8}, \frac{2}{8}, \frac{3}{4}, \frac{2}{8}$

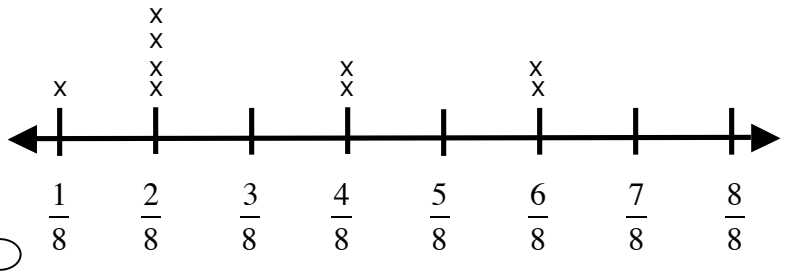
Convert to like denominators

$\frac{4}{8}; \frac{2}{8}; \frac{2}{8}; \frac{4}{8}; \frac{6}{8}; \frac{1}{8}; \frac{2}{8}; \frac{6}{8}; \frac{2}{8}$

Order fractions

$\frac{1}{8}; \frac{2}{8}; \frac{2}{8}; \frac{2}{8}; \frac{2}{8}; \frac{4}{8}; \frac{4}{8}; \frac{6}{8}; \frac{6}{8}$

Snow in January



This is a good reminder that students must always find like denominators to work with fractions.

This line plot also demonstrates trends and holes well.

Also, ask students if they could display the data differently? Why would you want to use a line plot instead of other options?

$= \frac{6}{8} + \frac{6}{8}$

$= \frac{12}{8}$

$= \frac{8+4}{8}$

$= \boxed{\frac{8}{8}} + \frac{4}{8}$

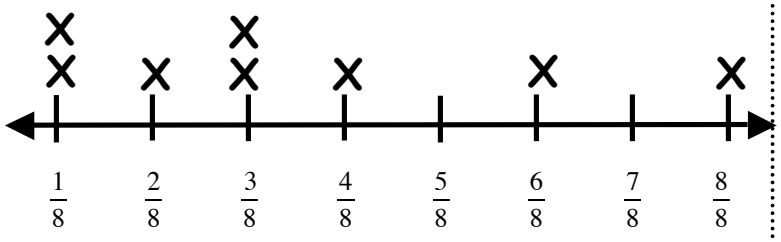
$= 1 + \frac{1}{2}$

$= \boxed{1\frac{1}{2}}$

∴ No, there was not enough snow to make a good snowman. There was only half as much as would be needed.

Ex. 3

Blake and his 7 friends are at a birthday party. They want to be fair, so everyone should get the same amount of ice cream. Right now, they all have different amounts of ice cream, and they charted the amounts on a line plot. How can they redistribute the ice cream so that everyone gets the same amount? How much ice cream will each person get?



amount of ice cream(cups)

After reading the problem twice, ask students:
What does it mean to redistribute? [to give out again]
So if we want to redistribute something like the ice cream, what would we need to do? [collect it all and then give it out again]
How would we give it out differently? [Give it away equally]
How would we know how much we had to give away? [add up all portions]
How would we know how many people will share the ice cream? [count the number of people at the party]
How many people are at the party? [8 = 7 guests plus Blake]
What is our plan for solving this problem? [to add up all the portions and then divide them by 8]

Total Amount of Ice Cream

$$= \frac{1}{8} + \frac{1}{8} + \frac{2}{8} + \frac{3}{8} + \frac{3}{8} + \frac{4}{8} + \frac{6}{8} + \frac{8}{8}$$

$$= \frac{28}{8}$$

$$= \frac{8+8+8+4}{8}$$

$$= \underbrace{\frac{8}{8} + \frac{8}{8} + \frac{8}{8}} + \frac{4}{8}$$

$$= 3 + \frac{1}{2}$$

$$= \boxed{3\frac{1}{2} \text{ or } \frac{7}{2}}$$

Redistribution of Ice Cream

$$= \frac{7}{2} \div 8$$

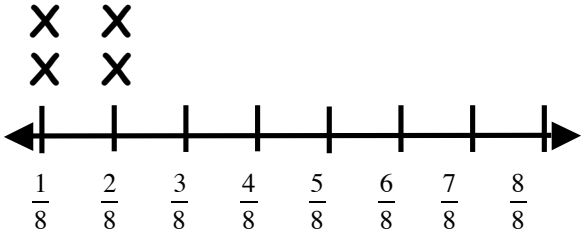
$$= \frac{7}{2} \times \frac{1}{8}$$

$$= \boxed{\frac{7}{16} \text{ cups of ice cream}}$$

$\therefore$ After the ice cream is redistributed fairly, Blake and his friends will each have $\frac{7}{16}$ of a cup of ice cream.

You Try!

CoCo is training for baseball season, so he is running sprints. His goal is to run 3 miles total, but he's not sure how many times to complete his sprint workout to reach his goal. He has charted the sprints of one complete sprint workout on a number plot. How many times must he complete his sprint workout to reach his goal?



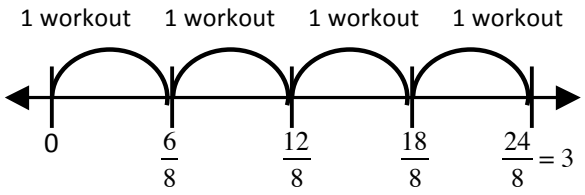
length of sprint (miles)

Total Distance in 1 Workout

$$= \frac{1}{8} + \frac{1}{8} + \frac{2}{8} + \frac{2}{8}$$

$$= \frac{6}{8} \text{ miles per workout}$$

Workouts Needed For 3 Miles



∴ CoCo must complete his sprint workout 4 times to have a combined distance of 3 miles.

Assessment:
With a partner complete the following 3 part task:

1) An artist had 10 boxes containing the following amounts of powdered chalk. Plot the measurements on a line plot.

$$4\frac{1}{2}kg,\ \ 3\frac{1}{4}kg,\ \ 2\frac{1}{2}kg,\ \ 2\frac{1}{2}kg,\ \ 4kg$$

$$3\frac{1}{4}kg,\ \ 4\frac{1}{4}kg,\ \ 5kg,\ \ 2\frac{1}{2}kg,\ \ 3\frac{1}{4}kg$$

2) Give the line plot a title and label the axis.

3) If the artist redistributed the powdered chalk equally among 10 new containers, how much chalk would be in each container? Explain your thinking.

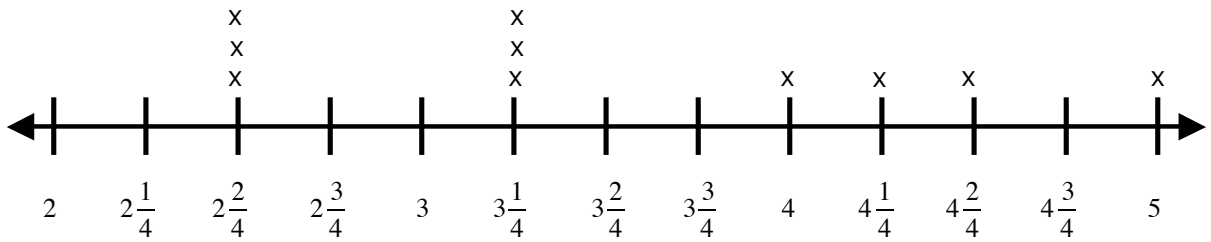
Assessment Key:

1&2) Converted Fractions

$$4\frac{2}{4}kg,\ 3\frac{1}{4}kg,\ 2\frac{2}{4}kg,\ 2\frac{2}{4}kg,\ 4kg,\ 3\frac{1}{4}kg,\ 4\frac{1}{4}kg,\ 5kg,\ 2\frac{2}{4}kg,\ 3\frac{1}{4}kg$$

Ordered Fractions

$$2\frac{2}{4}kg,\ 2\frac{2}{4}kg,\ 2\frac{2}{4}kg,\ 3\frac{1}{4}kg,\ 3\frac{1}{4}kg,\ 3\frac{1}{4}kg,\ 4kg,\ 4\frac{1}{4}kg,\ 4\frac{2}{4}kg,\ 5kg$$



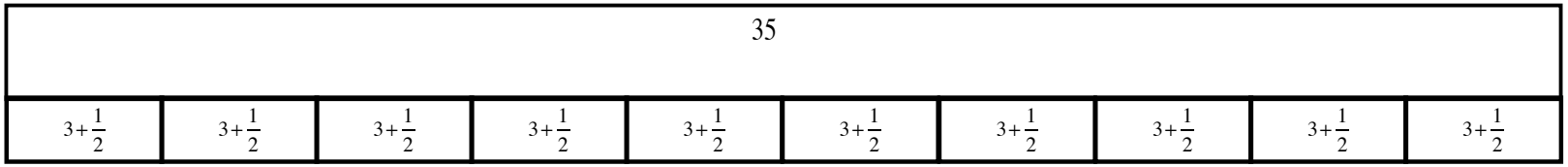
Amount of Powder Chalk (kg)

3)

Total Amount of Chalk

$$= 3\left(2\frac{2}{4}\right) + 3\left(3\frac{1}{4}\right) + 4\frac{1}{4} + 4\frac{2}{4} + 4 + 5$$
$$= 7\frac{2}{4} + 9\frac{3}{4} + 8\frac{3}{4} + 9$$
$$= 7 + 9 + 8 + 9 + \frac{2}{4} + \frac{3}{4} + \frac{3}{4}$$
$$= 33 + \frac{8}{4}$$
$$= 33 + 2$$
$$= \boxed{35}$$

Redistributed Powdered Chalk



$= 3 + \frac{1}{2}$

$= \boxed{3\frac{1}{2}}$

Each new container will hold $3\frac{1}{2}$ kg of powdered chalk. 30kg can be redistributed evenly between 10 containers by putting 3 kg in each container. 5 can be multiplied by an equivalent of one, $\frac{2}{2}$, which creates a fraction with a numerator that can be evenly distributed to ten containers, $\frac{10}{2}$. If $\frac{10}{2}$ is divvied up equally between the ten containers, each container would get $\frac{1}{2}$. That would mean each container will hold $3\frac{1}{2}$ kg of powdered chalk .

Warm-Up

5.OA.1	5.NBT.3
$2\times(5+4)$ (<) (=) (>) $(2\times5)+4$ five plus the quantity two times four (<) (=) (>) $4\times(2+5)$	Represent the value below in multiple notations. **1,349.572**

5.NBT.7

Simplify the expression below. Demonstrate your knowledge with a model, arithmetic, and words.

$$\frac{1}{2}\times\frac{5}{6}$$