INVESTIGATION 1.2: **Bracelet Links**

One of the most valuable bracelets is a Medical Alert Bracelet? The medical alert bracelet has saved the lives of many people since its invention in 1953 by 14 year-old Linda Collins and her father Dr. Marion Collins. Linda had been taken to the hospital after cutting her finger. She was given an allergy test for tetanus antitoxin before being given the full vaccination. Linda had a severe allergic reaction to the drop of tetanus antitoxin and nearly died. Afterwards Linda always carried with her information about her allergies. She tried keeping her information on a paper bracelet. But after having to make several bracelets, Linda got an idea for a silver bracelet engraved with “Allergic to Tetanus Antitoxin.” Her father created a design for the front of the bracelet that included the medical profession symbol and the title “MedicAlert.” A jeweler from San Francisco implemented the design and the MedicAlert bracelet was born.

Reference: [http://www.medicalert.org/about/aboutHistory.htm?selected=About+Us_History](http://www.medicalert.org/about/aboutHistory.htm?selected=About+Us_History)

For an art project, your class will make bracelets by linking different pieces together. Each bracelet must be 6 inches long. For this investigation, you are to explore the relationship between the length of each link and the number of links required to make the bracelet.

A  If each link is three inches long, how many links will be required to make the bracelet? Show your result graphically. How would you represent this problem numerically?

B  If each link is two inches long, how many links will be required to make the bracelet? Show your result graphically. How would you represent this problem numerically?

C  If each link is one inch long, how many links will be required to make the bracelet? Show your result graphically. How would you represent this problem numerically?
D If each link is one-half inch long, how many links will be required to make the bracelet? Show your result graphically. How would you represent this problem numerically? Discuss your result.

E If each link is one-third inch long, how many links will be required to make the bracelet? Show your result graphically. How would you represent this problem numerically? Discuss your result.

F If each link is two-thirds inches long, how many links will be required to make the bracelet? Show your result graphically. How would you represent this problem numerically?

G Compare your answers in Parts E and F. Explain why this happens.

H Suppose the bracelets were to be 12 inches long. How many links would be needed if each link is one-fourth inch long? Explain.

I If each bracelet is to be 12 inches long, how many links would be needed if each link is three-fourths inches long? Explain this in relation to Part H.

J Summarize what you have learned about dividing by a fraction.

K Challenge: If the bracelets were to be 15 inches long, how many links would be needed if each link is to be two-thirds inches long? Explain what is different here.
SAMPLE SOLUTION: **Bracelet Links**

A If each link is three inches long, how many links will be required to make the bracelet? Show your result graphically. How would you represent this problem numerically?

Students should find this simple, but it is important to activate their prior knowledge and to help them get the calculator skills they will need later in this problem. From the Main Menu, choose the Graph mode. Then,

- Press \( \text{SHIFT MENU} \) (SET UP). Scroll down and turn the **Grid** to Line and the **Axes Off** as shown below left. Press **EXIT** to return.

- Press \( \text{SHIFT} \) \( F3 \) (V-Window). Set the **Xmin** at 0, **max** at 6, and **scale** at 3. The 0 and 6 will represent the two endpoints of the bracelet, and our scale for the \( x \) represents the length of each link, which in Part A, is 3 inches.

- Set the **Ymin** at -1, **max** at 1, and **scale** at 0. See below right. (The scale for \( y \) is not visible.) Press **EXIT** to return to the home Graph screen.

- Make \( Y1 = 0 \) as shown below left. To do so, simply type in \( 0 \text{ EXE} \). This will produce a horizontal line that will represent our six-inch bracelet. See below left.

- Press \( F6 \) (DRAW) to see the graph. See below right.

The dark blue horizontal line represents the bracelet. This is the graph of \( Y = 0 \), and it begins at 0 and ends at 6. The vertical blue line in the middle of the screen represents the end of one link and the beginning of the other. In other words, the graph here represents two links that are put together to make the bracelet.
BRACELET LINKS (CONTINUED)

Numerically, of course, to show that there must be two links if each of the links is 3 inches long, we simply divide the length of the bracelet (6 inches) by the length of each link (3 inches in Part A), seeing again that there must be two links.

From the screen above,

- Press \text{MENU} \text{1} for the Run-Matrix mode. To show what has happened numerically, we simply take 6 and divide it by 3 as shown below.

\[
\begin{array}{c}
\text{6÷3} \\
\hline
\end{array}
\]

\[
\begin{array}{c}
0 \\
\hline
\end{array}
\]

If each link is two inches long, how many links will be required to make the bracelet? Show your result graphically. How would you represent this problem numerically?

From the MAIN MENU, choose Graph. Then,

- Press \text{SHIFT} \text{F3} (V-Window). Change the \text{scale} for \text{X} to 2, representing the two inches for each link of the bracelet. See below left. Press \text{EXIT}.

- Press \text{F6} (DRAW). See below right. Note that there are now three segments, representing the three links that are needed to make the six-inch bracelet.
To show this numerically,

Press [MENU] 1 to select Run-Matrix and show the division problem (6 inches divided by 2 inches for each link) as shown below.

If each link is one inch long, how many links will be required to make the bracelet? Show your result graphically. How would you represent this problem numerically?

We will continue in a similar fashion. We will change the scale on the X to represent the length of the link. Counting the segments on the graph represents the number of links, and the arithmetic should confirm the number of links found. See below.

As we hope students would expect, there will be six links if each is one inch in length.

If each link is one-half inch long, how many links will be required to make the bracelet? Show your result graphically. How would you represent this problem numerically? Discuss your result.
BRACELET LINKS (CONTINUED)

We continue in like fashion. Use the fraction key (\(\frac{a}{b}\)) to enter the fractions.

Here we find that it takes 12 links to make the bracelet. Because there are two halves in a whole, it will take 2 links to make each inch. Because there are 6 inches in the entire bracelet and we need 2 links for every inch, we will need 12 links. Thus we find that six divided by one-half is twelve. Students may also notice that it is also equivalent to six times two.
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**Topic:** Two-Variable Statistics

**NCTM Standards:**
- Understand the meaning of measurement data and categorical data, of univariate and bivariate data, and of the term variable.
- Understand histograms, parallel box plots, and scatterplots and use them to display data.
- Compute basic statistics and understand the distinction between a statistic and a parameter.
- Find, use, and interpret measures of center and spread, including mean and interquartile range.
- For univariate measurement data, be able to display the distribution, describe its shape, and select and calculate summary statistics.

**Objective**
The student will be able to calculate summary statistics for two sets of data simultaneously, make conjectures based on these statistics, and display the result in parallel box plots.

**Getting Started**
Have the students look online for the daily futures for Cocoa. Have the students decide how best to analyze the data.

**Prior to using this activity:**
- The student should be able to calculate Mean, Standard Deviation of a sample and a population.
- The students should be able to create a box and whisker plot and compare parallel box and whisker plots.

**Ways students can provide evidence of learning:**
- Given data, the student should be able to create a box and whisker plot.
- Given data, the student should be able compare a sample with an entire population.

**Common mistakes to be on the lookout for:**
- The student might have difficulty with analyzing their data, if they have outliers.

**Definitions:**
- Univariate
- Mean
- Conjecture
- Mode
- Parallel Box and Whisker plot
- Standard deviation of a sample
- Standard deviation of a population
- Median
- Ratio
- Bivariate
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“How-To”

The following will demonstrate how to enter sets of data into the Casio fx-9750GII, graph the data using a box and whisker plot, and calculate important data from the graph.

<table>
<thead>
<tr>
<th>Scores on the First Math Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scores on the Second Math Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
</tr>
</tbody>
</table>

To enter the data from the table in the problem:

1. From the Main Menu, highlight the STAT icon and press \( \text{Exe} \) or \( \text{2} \).

2. To clear previous data lists press: \( \text{F6} \) (▷) \( \text{F4} \) (DEL-A) \( \text{F1} \) (Yes).

3. Enter the data by typing each number, pressing \( \text{Exe} \) after each entry.

4. The display should look like the screen shot on the right when completed.

To select the type of graph for this data:

1. Press \( \text{F1} \) (GRPH).

2. Press \( \text{F1} \) (GPH1), then \( \text{F6} \) (SET) to set the type of graph for StatGraph1.

3. Press \( \boxed{\downarrow} \) to highlight the graph type.

4. Press \( \text{F6} \) (▷), then \( \text{F2} \) (Box).
5. Make sure the correct lists are chosen, then press EXIT.

6. Press F1 (GPH1) to display the graph.

**To graph parallel box and whisker plots:**

1. Press EXIT and press F6 (SET) to set the type of graph for StatGraph2.

2. Press F2 (GPH2), then ▼ to highlight the Graph Type.

3. Press F6 (▷), then F2 (Box).

4. Make sure the correct lists are chosen. If not, press ▼ to highlight XList; then F1 (LIST), input the number of the list and EXEC.

5. Press EXIT.

6. Press F4 (SEL) for multiple graphs to be displayed.

7. Make sure to turn on StatGraph1 and StatGraph2. Use ▲ ▼ to move between the graph choices. Press F1 (On) for both StatGraph1 and StatGraph2. Now, press F6 (DRAW) to draw the parallel graphs.
World Cocoa Market Activity

The latest statistics on the cocoa market can be found at the following website: [www.dailyfutures.com/softs](http://www.dailyfutures.com/softs). On this website, the net production and grindings statistics for each of the years is listed in a chart. For this activity, we will use the following data:

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Production</td>
<td>2.91</td>
<td>2.67</td>
<td>2.67</td>
<td>2.77</td>
<td>3.03</td>
<td>2.83</td>
<td>2.86</td>
<td>3.14</td>
<td>3.42</td>
</tr>
<tr>
<td>Grindings</td>
<td>2.66</td>
<td>2.75</td>
<td>2.75</td>
<td>2.78</td>
<td>2.96</td>
<td>3.04</td>
<td>2.88</td>
<td>3.05</td>
<td>3.18</td>
</tr>
</tbody>
</table>

Questions

1. Find the average net production and grindings.
   
   Average Net Production: _____________
   Average Grindings: _____________

2. What is the ratio between those two numbers?
   _____________

3. What does the ratio from number 2 represent?
   _____________
   _____________

4. Find the median for net productions and net grindings.
   
   Net Production: _____________
   Net Grindings: _____________

5. Find the standard deviation of the sample for net productions and net grindings.
   
   Net Production: _____________
   Net Grindings: _____________
6. Find the standard deviation of the population for net productions and net grindings.

Net Production _____________
Net Grindings _____________

7. What do the mean, standard deviation of the sample and standard deviation of the population represent for net production and grindings?
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

8. Create parallel box and whisker plots for the net production and grindings. Draw and label the plots in the space below.

9. Compare and contrast the two plots.
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

Extension

Look online and find more information about the future of a product that you are interested in. Also, talk to your Economics teacher about how futures play a role in the economy.
Reach the Goal!

Learning Target:
Students will use the calculator to explore the concept of multiplying a whole number by a fraction.

CCSSM:
6.NS, 7.NS

Materials:
Calculator

This game will help students understand what happens when they multiply a whole number by a fraction.

• The Player 1 enters the beginning number on the calculator.
• Then the players take turns multiplying that number by a fraction.
• The first player that gets an answer within the goal range is the winner!

Sample:
Beginning number: 200  Goal Range: 110 to 120

Player 1 enters 200 \times \frac{1}{3} = 66.6667
Player 2 enters  \times \frac{3}{2} = 100
Player 1 enters  \times \frac{5}{4} = 125
Player 2 enters  \times \frac{11}{12} = 114.58

Player 2 is the winner!!

Additional Games:
1. Beginning number: 500  Goal Range: 354 to 364
2. Beginning number: 172  Goal Range: 66 to 76
3. Beginning number: 553  Goal Range: 214 to 224
4. Beginning number: 475  Goal Range: 198 to 208
5. Beginning number: 430  Goal Range: 54 to 64

Extension:
*Play the same game using multiplication of whole numbers and decimals.
*Play the same game using division of whole numbers and decimals.