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PAPER CLIP CHAINS

Topic

Proportional Reasoning – Rates

Key Question

You have a chain of standard paper clips and your friend has a chain of jumbo paper clips. If your friend told you the length of objects in jumbo clips, how could you change that number into standard clip lengths?

Focus

Students will measure objects with standard and jumbo paper clips. They will then graph and analyze the data to develop their understanding of proportional reasoning as related to rates and graphic displays.

Guiding Documents

Project 2061 Benchmarks

- *Organize information in simple tables and graphs and identify relationships they reveal.*
- *The graphic display of numbers may help to show patterns such as trends, varying rates of change, gaps, or clusters. Such patterns sometimes can be used to make predictions about the phenomena being graphed.*

NRC Standards

- *Use appropriate tools and techniques to gather, analyze, and interpret data.*
- *Mathematics is important in all aspects of scientific inquiry.*

NCTM Standards

- *Develop formulas and procedures for determining measures to solve problems*
- *Understand and apply ratios, proportions, and percents in a wide variety of situations*
- *Analyze functional relationships to explain how a change in one quantity results in another*
- *Use patterns and functions to represent and solve problems*

Math

Proportional reasoning
Patterns and functions
Measuring
length
Graphing

Integrated Processes

Observing
Collecting and recording data
Interpreting data
Drawing conclusions
Applying and generalizing

Materials

Jumbo paper clips, 12 per group
Standard paper clips, 19 per group



Background Information

Conversion rates are factors by which you multiply one measurement unit to get a different type of unit. The conversion rate is determined by using a ratio to compare the quantity in one system to an equal value in the other system. When the ratio is reduced to a unit rate, with a one as the denominator, you have the conversion rate for the two types of measures.

For paper clips the length of 9 standard clips is the same as 6 jumbo clips. The conversion ratio would be 9 standard clips to 6 jumbo clips (9/6). As a unit ratio this would be 1.5 standard clips for each (1) jumbo clip (1.5/1). The one in the denominator is assumed and the rate is recorded as 1.5 standard/jumbo. Multiplying the number of jumbo clips required to measure a length by 1.5 gives the length in standard clips.

The proportional nature of rates is shown graphically on a coordinate graph with each of the axes representing one system of measurement. When a number of different lengths are graphed with each point at the intersection of the length's corresponding quantity in each system, a line results. The slope of this line is the conversion rate between the two systems.

Management

1. This activity works well in groups of two with one partner measuring objects with a jumbo clip chain and the other measuring the same object with the standard clip chain.
2. To get more consistent results as a class, the teacher may choose to pre-select the items to be measured by students. In choosing items there needs to be a variety of lengths from one jumbo paper clip to 12 jumbo clips.
3. The investigation is divided into two parts to allow for flexibility. Classes with some experience with ratios will want to start with *Part B* and use *Part A* only if students

experience difficulty or could benefit from clarification. Less experienced classes would start with *Part A*, which may be the only part done. They could use the graph to determine the conversion for unmeasured lengths. *Part B* could be used when students become better grounded in the concept of ratio.

Procedure

Part A

1. Distribute paper clips of both sizes and have student groups make a chain for each size of paper clip.
2. Pose the idea that lengths could be measured by chains of paper clips and have the students suggest what problems might arise if they used the chains they made.
3. Have students lay the chains side by side with one end of each chain matched with the other chain.
4. Have students observe and record how long in standard paper clips the given amount of jumbo clips are.
5. Have students make a coordinate graph of the data.
6. Discuss with students the patterns they see in the graph and their relation to the data. Have them consider how they can use the patterns to convert lengths in jumbo paper clip units to standard paper clip units.
7. Use a jumbo chain to measure items that are not one of the given lengths. Have students determine the items' lengths in standard paper clips and check their answers with a standard clip chain. Have them discuss the various strategies they used to get their answers.

Part B

1. Pose the *Key Question* and have students discuss how they might solve the problem.
2. Have student groups make a chain for both sizes of paper clips.
3. Using *Part B* activity sheet, have students measure and record the lengths of six objects in both standard and jumbo paper clip units.
4. Have students make a coordinate graph of the data.
5. Discuss with students the patterns they see in the graph and their relation to the data. Have them consider how they can use the patterns to convert lengths in jumbo paper clips to standard paper clip units.
6. Connect several jumbo chains and measure larger objects in the room and have students use their patterns to determine the length in standard paper clip units. Several small chains can be connected and used to confirm the results. Have them discuss the various strategies they used to get their answers.

Discussion

1. What patterns do you see in the chart? [For every two jumbo clips there are three standard clips.]
2. How many times bigger is the standard clip number than the big clip number? [1.5]
3. What patterns do you see in the graph? [The points make a straight line.]
4. How do the patterns you found in the chart show up on the graph? [To stay on the line you go up three standard clips and over two jumbo clips. To stay on the line you go up 1.5 units for every one you go sideways.]
5. How could you use the patterns to determine the length of something in standard clips if you know its length in jumbo clips? [jumbo clips \times 1.5 = standard clips, interpolate or extrapolate the line on the graph.]
6. What are some types of measurement conversions that might be more practical than jumbo clips to standard clips?

Extensions

1. Make conversion rates for other standard units such as hex-a-link cubes, Unifix cubes, floor tiles.
2. Develop conversion rates to do estimations such as feet/step, centimeters/hand span, yards/arm span.

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Key Question

You have a chain of standard paper clips and your friend has a chain of jumbo paper clips. If your friend told you the length of objects in jumbo clips, how could you change that number into standard clip lengths?

Learning Goal

Students will:

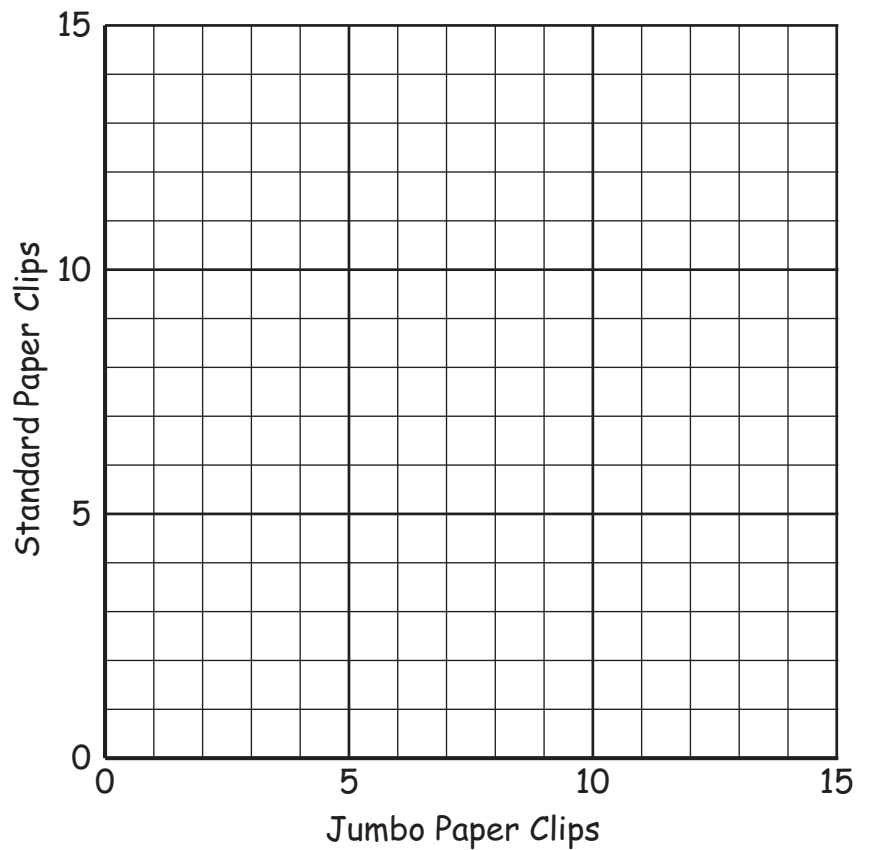


measure objects with standard and jumbo paper clips. They will then graph and analyze the data to develop their understanding of proportional reasoning as related to rates and graphic displays.

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Part A

| Jumbo Clips Long | Standard Clips Long | Standard Clips for Each Jumbo Clip |
|------------------|---------------------|------------------------------------|
| 2 | | |
| 4 | | |
| 6 | | |
| 8 | | |
| 10 | | |
| 12 | | |

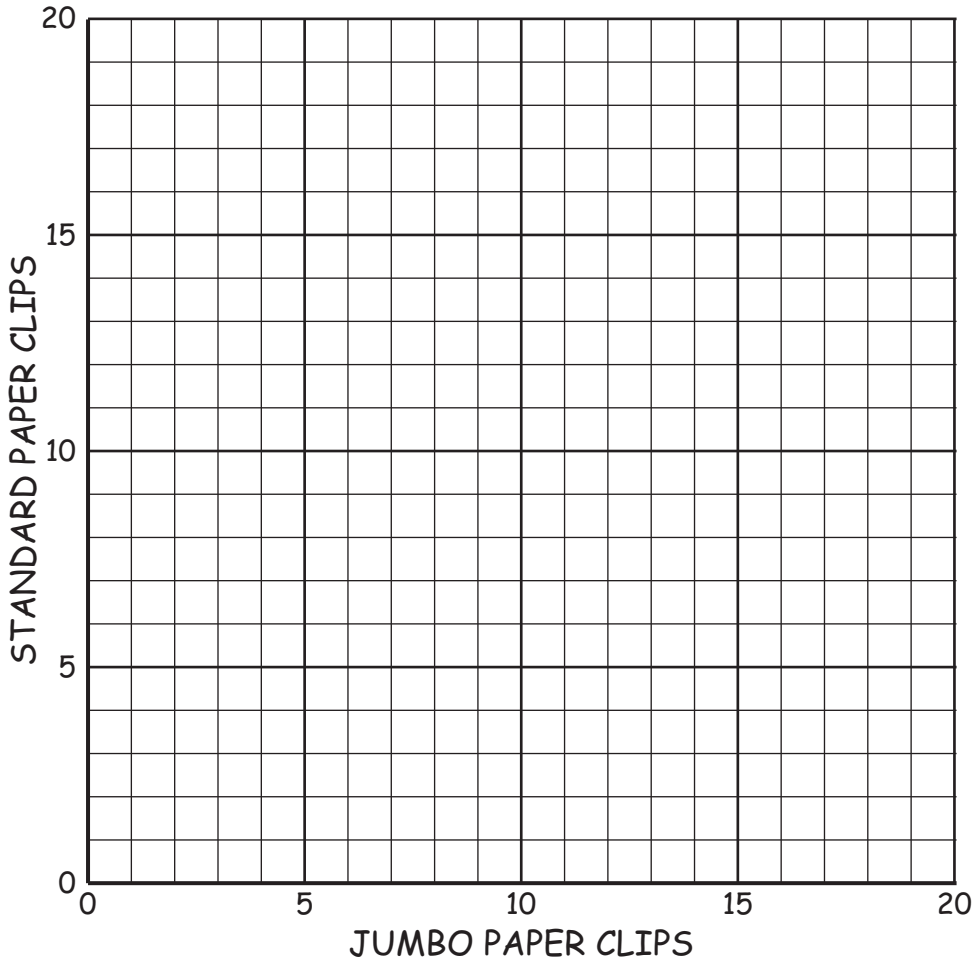


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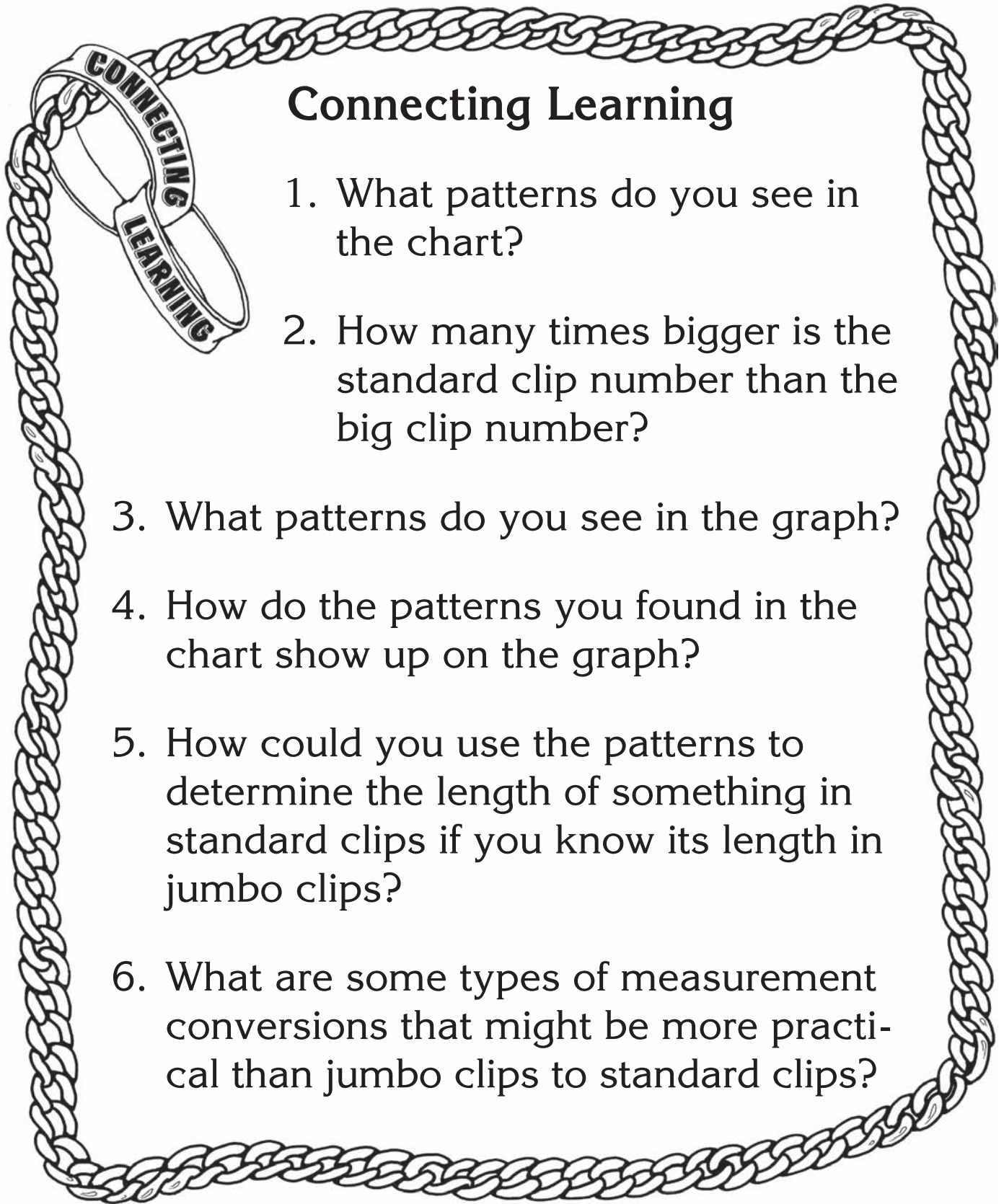
Part B



| Object Measured | Jumbo Clips Long | Standard Clips Long | Standard Clips for Each Jumbo Clip |
|-----------------|------------------|---------------------|------------------------------------|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
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PAPER CLIP CHAINS



Connecting Learning

1. What patterns do you see in the chart?
2. How many times bigger is the standard clip number than the big clip number?
3. What patterns do you see in the graph?
4. How do the patterns you found in the chart show up on the graph?
5. How could you use the patterns to determine the length of something in standard clips if you know its length in jumbo clips?
6. What are some types of measurement conversions that might be more practical than jumbo clips to standard clips?