INTRO TO DATA: PICTOGRAPHS & BAR GRAPHS

GRADES K–2

COMMON MISCONCEPTIONS

• **Students draw pictures of different sizes.**

In a pictogram, all the pictures should be the same size. In grade two, pictographs are generally drawn with pictures that represent the objects, instead of dots or other general shapes. This helps capture students’ interest and makes the graph seem more concrete. It is easier for a student to see that the number of soccer balls in the graph represents the number of people who like soccer than using a more abstract, generic image. In grade 3, students begin using more generic images like dots. The challenge with using these more complex images is that students may not have the visuomotor skill to draw equal-sized pictures. Having the pictures in different sizes can interfere with students learning that the length of the line of pictures represents the number of items. To address this, use grid paper. Students often find it easier to draw their graphs on grid paper than loose leaf. You can also provide students with a blank graph with empty squares to draw the pictures in or have students use stickers, so they don’t need to draw at all.

• **Students do not connect the number of items to the height of the bar.**

Some students may have difficulty keeping track of their tally marks and converting their counts into the height of the bars in a bar graph. To remedy this, use manipulatives like Omnifix cubes or blocks to have the student build a physical bar graph before drawing the graph on paper. You can have the student use the blocks for counting, along with their tally marks, and then stack the cubes to make the bar graph. This also reinforces the connection between the pictograph and the bar graph. To help students keep track of tally marks, you can have them arrange popsicle sticks to represent the count before recording the tally marks on paper.

• **Students think graphing is not important.**

Some students do not see the connection between representing data in graphs and real-world applications. This perceived irrelevance can make it hard for students to focus on the material and learn the concept. It can also decrease long-term retention. To make learning relevant, try having students conduct “research projects” to answer questions they have. You can have them build surveys, collect their data, graph it, and then present their findings to the class. It is also helpful to use examples from various professional fields and discuss how data collection and graphing relate to each one. For instance, biologists use bar graphs to represent data on the number of dolphins in an area. An ice cream shop owner may use a bar graph to show what ice cream flavors people buy. Data and graphs are relevant and valuable, and students must understand this.

DATA & MEASUREMENT

Measurement is the act of sizing attributes. When we measure the attributes of many objects, we are collecting data.
The type of attribute we measure determines the measurement tool we use and the type of data that measurement produces. There are two main types of data, quantitative and qualitative. Qualitative data includes subjective things, like a person’s experience, narratives, interviews, or artifacts. Qualitative data also includes attributes that can be used to sort items into categories; this produces categorical data, sized by counting the number of items in each category. The counts obtained from categorical data are called frequencies. Quantitative data can be naturally ascribed a numerical value; this includes attributes like length, weight, or volume. The methods for summarizing, describing, and representing data are different for categorical and quantitative data. In this lesson, students learn how to use pictographs and bar graphs to represent categorical data, but this data can also be represented using pie charts, frequency tables, or relative frequency tables. We find relative frequency by dividing the number of objects in each category by the total number of objects, to represent the proportion of objects in each category and allowing for comparisons across multiple data sets. It is vital to keep the broader context of measurement and data in mind when introducing this concept. Students must be aware early that there are different types of data and that measurement creates data. This is fundamental for understanding the foundations of statistics and many concepts in the sciences.

PICTOGRAPHS

Graphs are a visual representation of data and are used to make data more intuitive and interpretable. In a pictograph, we use pictures to represent the count of items in each category. In grade 2, each picture is worth one item in the real world. In future grades, students will learn how to draw and read pictographs with a scale. A scale pictograph has a key indicating that each picture is worth something other than one. For example, one picture in the pictograph may be worth five items in the real world. When drawing pictographs, it is important that all the pictures are the same size so that the length of each row of pictures and the number of pictures in the row are directly related. Some students do not draw their pictures the same size, and this makes it look like categories with larger pictures have more, and smaller pictures have less, which is inaccurate. A bar graph is constructed similarly to the pictograph, but instead of pictures, we use a rectangular bar to represent the count.

BAR GRAPHS

Bar graphs have two axes, one to show the categories, and the others to represent the count of each category. It is important that the width of the bars is the same and that the bars are equally spaced on the graph. It is also important that the bars on the bar graph do not touch. When the bars are touching, the graph is called a histogram. Histograms are used to show the density of data points within “bins” that contain a range of measurement values. Because the data used to make a histogram is continuous, the bars touch to show that the data is quantitative and continuous. Many students confuse bar graphs and histograms because they are so similar. In a bar graph, the data we display is the count of items in discrete, mutually exclusive categories. Because each category is separate, we can rearrange the order of the categories on the graph without changing the graph’s meaning. Bins are similar to categories, but the order of the bins matters, since each bin has a position on a number line. Emphasizing that the “gap” between bars is because each category is separate can help prime students to understand the difference between bar graphs and histograms in future grades.

TEACHER TIPS

Keep learning relevant and fun. Use manipulatives to build graphs from blocks, counters, or pictures before drawing them on paper. Ask students what the graphs mean, and have them explain the data. Discuss the attributes that you use to define the categories, and engage students in designing their own questions to answer using graphs.