Measurable Attributes

Introduction to Measurement

1 Prep

This lesson requires a few objects that have varied attributes for the purpose of a class discussion, as well as more objects for student groups to observe. For example, for the class discussion: a stuffed animal or other toy (a toy that moves or makes sounds gives more examples of attributes), colorful masses from the mass set, and a muffin. These objects have lots of attributes the students may observe: color, sound, speed, shape, weight, height, scent, flavor, temperature, etc.

After a class discussion about these objects, students break into groups to make observations about more objects, so two to three additional objects are needed per group. Variety in the objects is desirable, but the objects can be just about anything and can likely be found around the classroom: pencils, books, manipulatives, etc.

You will also need rulers for the teacher to use and the students to look at. Other class measuring tools should be handy too (e.g. meter stick, measuring tape, scale).

2 Attributes

What are "attributes"?
Attributes are: features, characteristics, traits, qualities. They are the types of things that we use to describe objects. The types of things our senses notice about the object. What can we see about the object? How does the object feel? Does it have a smell? A sound? A taste?

Introduce the objects for the class discussion, and guide a discussion about their attributes. Ask leading questions as necessary:
If you wanted to describe this toy to a friend who has never seen it, what would you say?
If you met an alien who had no idea what a muffin is, could you describe it?
Let's think about our five senses. Can our senses notice anything about these objects?
Let's compare and contrast. What do these objects have in common? What are their differences?

As the students contribute possible attributes, point out any contributions that have to do with size. Mention that these are important types of attributes, and we will come back to them later.
Here are some words about size that may come up:

Some common words (adjectives) about size:

big	***short***	***low***
large	***tall***	***deep***
small	***medium***	***big around***
tiny	***wide***	***small around***
heavy	***narrow***	
light	***high***	

Related math words (nouns) about size:

height	***weight***	***diameter***
width	***mass***	***girth***
length	***area***	***circumference***
depth	***volume***	

These size-related attributes will be the measurable attributes we get to by the end of the lesson, which is the reason we want to point them out as important as they come up (though we will wait to reveal why they are important at this point). You might consider making a list of any size-related words that you hear a student say on the board.

Other attributes are equally good contributions. They might include (or be related to):
color
texture
smell
taste
temperature
sound
speed
shape
age
position
number of eyes, ears, legs, wheels, blueberries...

Some of these attributes are also measurable, though perhaps not by tools we have access to, and their measurements may not be covered by our objectives. However, mentioning the existence of these tools is an optional part of this lesson; see Section 4, Optional Further Discussion Topics, at the end of this lesson.

As the students are getting the hang of the idea of attributes, introduce the small group objects and let them discuss the attributes of these new objects (which they have the advantage of being able to examine up close and touch). After they have discussed in groups, come back together and share with the class some of the attributes they found.

3 Measurement

After the discussions about attributes have reached a satisfactory point for moving on, we transition to the idea of measurement. Remind them about some of the size-related words they have said; refer back to the list on the board if there is one. Pick out an example; maybe someone noticed that the toy was the largest object in the original class discussion, and they said that it was "big." The idea of measurement stems from going one step further than noticing the object is big, to asking *how* big is it? This question has to do with comparison. The toy is big compared to the other objects we were looking at. It is big compared to a marble, or an eraser, or a grain of sand. But, is it big compared to the desk? Is it big compared to a house? No, it is not. So, how big is it?

Guide the students in a discussion about how to communicate how big the toy is. How could we tell someone who had never seen the toy how big it is? Here are some points that could be fleshed out as the student participation gets close to these ideas:

- What exactly did we mean by "big"? There are different types of being big. When we say something is big, we could mean it is:
  - tall
  - heavy
  - wide
  - big around
  - deep
- We could compare the toy's size to something else, something that has a size the other person already knows. We can start with finding size ranges. Starting with big size ranges and then making them closer and closer to the right size can be helpful:
  - The toy is shorter than a door, but taller than a pea.
  - The toy is shorter than me, but taller than the length of my hand.

  - The toy is shorter than this book, but taller than this cup.
- Instead of finding one object that is just the right size (which can be difficult), we can instead compare to multiples of an item.
  - The toy is about as tall as five pencil boxes stacked on top of each other.
  - The toy is about as wide as four new crayons, laid end to end. (The importance of having no gaps and no overlaps between the crayons can be discussed now, if desired: Why is it important the crayons are touching end-to-end? What if I take these four crayons and lay them out with gaps between? If this still the same length as the toy? What if I overlap the crayons? Is this still the same length? We use no gaps, no overlaps, so that when we say the toy is as long as four crayons, we understand what size that means.)
- What kind of objects are best to compare to?
  - The toy is about as long as my shoe, but what about this toddler shoe? The toddler shoe is much shorter than the toy. So if we say the toy is as long as a shoe, is that enough information?
  - Are there any objects we can compare to that are always the same size?

Tools for Measuring
Guess what? We have just been **measuring**! What does it mean to measure? When we measure, we use numbers to understand and describe some of the attributes of objects. For example, when we said that the toy was about the same length as four crayons, we were measuring the length of the toy. Another way to measure is to use a tool, like a ruler.

Introduce the rulers; give a ruler to each group or each student to inspect. Talk about the numbers and lines as tools to help use measure how long or tall or something is. The numbers on one side count something called inches, and the numbers on the other side count something called centimeters. Inches and centimeters are very special because they are always the same size (not like shoes!).

Demonstrate measuring the height of the toy in inches (or centimeters). Now we can say that the toy is 10 inches tall, and anyone who knows about inches, or has a ruler, can know just how tall the toy is.

Which attributes can we measure?
Now we think back to all of the attributes we came up with for the objects (the toy, masses, muffin, and the small group objects). Which ones can we measure? The attributes that we will measure in class will be the attributes about size we said were important before.

Show the students some of the other tools we will use to measure, like a meter stick, measuring tape, and a scale.

- We can measure how tall something is using a ruler or a meter stick.
  (Math words: height, width, length, depth)
- We can measure how big around something is using a measuring tape.
  (Math words: girth, circumference)
- We can measure how heavy something is using a scale.
  (Math word: weight)

These attributes are called **measurable attributes** because they are the ones we can measure.

Important Notes About Measuring

- Orientation: If we think about the length of a pencil, that attribute does not change based on orientation. The pencil has the same length whether I hold it vertically in the air, lay it horizontally on the desk, or stick it behind my ear. Another good example is a person's height. Rachel is 5 feet tall. If she lays on her bed, she is still 5 feet tall, even though her orientation has changed. This is not an easy concept, since we think of height as being a vertical measurement, and Rachel's height is no longer vertically oriented while she is laying down. One way to reconcile this is to think of an object's height as being the vertical measurement in its agreed upon "natural" state.

- A related issue is understanding that an object's length/width/height is constant, regardless of where on the ruler we choose to measure. Illustrate this point using metal rulers and magnets. If I stick the magnet at the end of the ruler, starting at the 0 tick mark, and it measures 2 inches long, then the magnet is still 2 inches long when I slide it further down the ruler, say starting at the 3 tick mark and ending at the 5 tick mark.

4 Optional Further Discussion Topics

- **Why do we measure? Where do we see measurement happening in our lives?**
  - We measure to notice things changing. Nurses and doctors take measurements about our bodies to see that we are changing and growing and that we are healthy. They can measure our height, weight, temperature, heart rate, blood pressure, etc.
  - We measure to make things. Builders have to measure lots of things in order to make buildings – like the ground, wood, and bricks. Bakers have to measure ingredients – like flour and sugar – in order to make cakes.
  - We measure to record and predict. Meteorologists measure things like temperature, rain fall, air pressure, and humidity. They use these measurements to help us know more about the best times for farmers to plant crops and when a storm might be coming.
  - The machines all around us are measuring things so that they can work correctly and safely. The refrigerator, oven, and air conditioner measure temperatures. Cars measure lots of things, like speed, tire pressure, and fuel. Clocks measure time.

- **Examples of cool things people measure:**
  - sound: we can measure how loud something is using a decibel reader (this is a fun one to measure in class using a decibel reader app on a smartphone)
  - speed: police officers measure how fast cars are moving using radar guns
  - taste: the Scoville scale is a tool for measuring the spiciness of peppers
  - color can be measured by a spectrophotometer
  - earthquakes can be measured using a seismograph and the Richter scale

5 Standards

K.MD.A.1 Describe the measurable attributes of an object, such as length (long/short), height (tall/short), or weight (heavy/light).

K.MD.A.2 Directly compare two objects with a measurable attribute in common, to describe which object has more of/less of the attribute. For example, directly compare the heights of two children and describe one child as taller/shorter