

## Estimation and Measurement

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### Purpose

To use unconventional units of measure to estimate and measure.

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### Context

Before doing this lesson, students should have many opportunities to experiment with the process of measuring. Students need to explore various materials with different kinds of measuring tools without any focus on particular units of measurement, measuring accurately, or understanding differences between kinds of measurement (length versus weight, for example). Exposure to measuring in an exploratory environment familiarizes children with the concept of measurement and tools of measurement.

Once students have this familiarity, they are ready to be introduced to the idea of units of measurement. Students will first measure with the idea of units in mind and then be challenged to consider why it is important to have standardized units of measurement. From here, students will measure with standardized units and compare conclusions with one another.

Measuring with a standard unit (beginning with an unconventional unit such as a toothpick) will give students a base for estimating measurement. Using the same unit to measure different things will help students begin to visualize how many "toothpicks" it will take to measure a length of something. When students are able to visualize in this way, they are able to make reasonable estimations. (Note: You'll need to decide whether to use the term "estimate" or "guess" throughout this lesson, depending on the level of your students.)

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### Planning Ahead

Materials:

- *Miss Nelson is Missing* (by Harry Allard)
- candy bars
- toothpicks
- paper
- unconventional units of measurement
- conventional tools for measuring
- [Measuring with Toothpicks](#) student sheet (optional)

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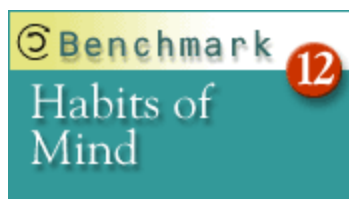
### Motivation

To get students thinking about units of measurement, incorporate the ideas outlined in [Non-Standard Measuring](#), on The Math Forum website.

You will need to consider the most appropriate way to chart students' results, depending on the grade level with which you are working. An alternative to

#### **9A Numbers #3**

It is possible (and often useful) to estimate quantities without knowing them exactly....



#### **12B Computation and Estimation #1**

Use whole numbers and simple, everyday fractions in ordering, counting, identifying, measuring, and describing things and experiences....

#### **12B Computation and Estimation #5**

Make quantitative estimates of familiar lengths, weights, and time intervals and check them by measurements....

### Resources

- [The Math Forum](#)

students writing a description of what happened when they measured with candy bars (as suggested on the website) is to facilitate a group discussion.

You could display the various candy bars that students used for measuring and ask questions like:

- Are all these candy bars the same size?
- When you measured the same object with different candy bars, what happened?
- What can we learn about the measured object when different partners use different sized candy bars?
- What would happen if we all used the same kind of candy bar? (Let students try this and then reconvene.)
- What can we learn about the measured objects when we use the same candy bar? Is it easier to know what we are describing to each other?

These and similar questions get at why standardized units are useful.

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## Development

Ask students what other things they could measure with. Have them come up with ideas of what to measure with and let them explore the classroom with these unconventional measuring tools.

Now is a good time to introduce a standardized unit of measurement. Toothpicks are a fun unit to start with. As part of your presentation of toothpicks, encourage students to consider why these toothpicks might be more useful than the candy bars or the other units they may have been using around the classroom.

Display a group of candy bars and a group of toothpicks. Ask the following questions:

- What is different about these two groups?
- If everyone needed to measure in the same way, which group would be better to use and why?
- What is helpful about using units that are the same size?

With more understanding of the usefulness of standardized units of measurement, students are ready to use these units for measuring and estimating measurement.

In this part of the lesson, students will measure a piece of paper with toothpicks. Each student will have the same size piece of paper and the same size toothpicks.

Depending on the level of your students, you could either distribute the [Measuring with Toothpicks](#) student sheet for the students to work on independently, or you could guide students through the toothpick activity, with or without the student sheet.

As students are working on their toothpick measuring, they will likely need to problem solve about what to do when their paper space is not equal to the lengths of their toothpicks. You can help them recognize that using part of a toothpick might help them solve this problem. In very tangible terms, students are working with whole numbers and fractions.

The more students measure with toothpicks, the more comfortable they will feel in estimating a "toothpick measurement."

To help students think about why estimation can be useful, you might ask:

- What could we do if we needed to tell our friend what size our paper is,

- but we do not have our toothpicks with us?
- If our friend told us that her paper is about 10 toothpicks long, what do you think that looks like?
  - What helps you guess the size of something?

Students can work more with estimation by exploring their environment and estimating the size of things. For example, you can ask them to go on a “size hunt.” They can go in search of things that are four toothpicks long (or whatever size you choose). Have them make a collection of these items, and then they can actually measure them for comparison.

Estimation is a concept that you can incorporate into your everyday routine. At meeting time, perhaps students can estimate how many children are present, and then do a head count. At clean-up time, they can estimate how long it will take for the class to clean up, and then check the timer. Perhaps at a meal time or during a cooking activity, students can estimate how much of a food or an ingredient will fill the bowl, and then measure how much. These kinds of simple questions help students practice their estimation skills.

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### Assessment

As a way to have students reflect on what they have experienced with measurement, it might be fun to write a group story (or individually, depending on your group) about what happened when Miss Viola Swamp had them measuring with different sized candy bars. In contrast to the chaos this produced, they can help write about what happened when they began measuring with the same kind of candy bar. The story could end with putting this contrast into a simple, complete sentence. Students could respond to, “The difference between using different sized candy bars and same sized candy bars is...”.

You can also help students put their toothpick measurement findings into a math sentence like, “My paper is five whole toothpicks and part of one toothpick long.” Students could share their results in a group setting to help them see that, since they each had the same size piece of paper and used the same size toothpicks, their results are very similar. (You could help any student who may have difficulty with this activity before the group sharing, so that no one feels embarrassed.)

To help students review what they have been practicing with measurement and estimation and to reinforce how these concepts may be applied, ask them the following questions:

- What else in the classroom could you use for measuring?
- Why did you choose this “unit” of measurement?
- If you had to measure the length of this classroom, would your unit be an easy or difficult one to use? Why?
- What if you had to measure the length of a pencil? What would be a good unit to use?

These summarizing activities help students reflect upon: 1) why it is helpful to use standardized units of measurement; 2) how using whole units and parts of units (whole numbers and fractions) help describe an object; 3) how estimation can help describe an object’s measurement to somebody else, even when you do not have a measuring tool available.

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### Extensions

By using question #7 on the [Measuring with Toothpicks](#) student sheet as a class problem, students can practice their estimation skills. Have students work with a partner in a role-play. One student can pretend to be the book-cover maker and the other student can be the owner of the book. With no actual toothpicks available, the owner should describe (estimate) the length and width of the book

to the book-cover maker. You can use this exercise as a short role-play or have the book-cover makers actually cut paper according to her/his understanding of the owner's description. The idea is to help students begin to see that using the same unit of measurement allows us to estimate, and estimation helps us give information to another person.

Students can set up other role-plays incorporating estimation. They might enjoy using silly, unconventional units of measurement for their role-plays. When students are ready, you can begin introducing more conventional units.

You can offer students conventional units of measurement and ask them to consider which tools they would choose for measuring the length of the chalkboard, a chair, a pencil, the wall, etc. Students do not need to be able to measure with these tools accurately, but this exercise will help students begin to see that different measuring tools are more efficient and easier to use with different objects. For example, using a ruler to measure a pencil is easier than using a yardstick, but using a yardstick for measuring the floor is easier than using a ruler.

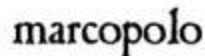
Also, students can begin to recognize that scales measure weight and rulers measure inches. Although they are not developmentally ready to master the concept of volume, you can help them begin to use appropriate labeling for their measurements. You can model this when you introduce measuring tools, and they will begin to incorporate the appropriate measurement wording as they experiment. Again, they may not be accurate in their measurements, but they will begin to understand that a pencil is six inches long and the ball weighs two pounds.

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For other creative ideas regarding estimation and measurement, see the following web pages:

- [Inch by Inch](#)
- [Introduction to Measurement for Primary Students](#)
- [Fun with Math](#)

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