

# **Estimation Station**

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## **Overview**

Many students in the United States do not have the necessary math skills for success in today's world (Lago & DiPerna, 2010). With technology so prominent in the workplace, employees must possess a higher skill level in mathematics. Not only do we need to prepare for the mathematics in technological advances, but math oriented jobs tend to generate higher incomes. For students to achieve mathematically, early learning of number sense is essential (Lago & DiPerna, 2010). Number sense involves many different aspects of mathematics, of which estimation is one of the basic skills.

Estimation can be a difficult concept to teach. Students would rather find the exact answer to a problem or question rather than making an estimate. An estimate can seem like extra work. It is a challenging task for young children developmentally. John A. Van de Walle, a math education researcher, states that "Estimation is a higher-level skill that requires students to be able to conceptualize and mentally manipulate numbers" (Hoffman, 2011). In estimating, students must complete extra work by analyzing the problem. Students must ask questions and make decisions based on their knowledge and clues they receive.

In this unit I define estimation, why it is an important concept to teach, and some strategies and techniques to use when teaching estimation to young children. This unit includes 5 diverse lessons on estimation. Lessons are intended for kindergarten students but can be adapted for older grades. The lessons have a fall theme, but can be easily changed to match any theme.

## Rationale

What is estimation?

Estimation is often referred to as a guess, but it is not simply just a guess. It is a guess that is informed and knowledgeable. Estimation uses personal knowledge, experience, and thinking skills to make a rough calculation. An estimation judges how much, how long, or how many without an exact answer.

Why is estimation important?

Estimation is a skill we use each and every day. How long will it take to get there? How much will the groceries be? What time will supper be ready? When do you think you'll need to get gas? The answer to each of these questions will be an estimate. An estimate is sufficient enough to answer these questions. A person might not have the time, knowledge, or resources to get exact answers to these questions, or the motivation. We accept estimation as the answer because we understand it may be difficult and time consuming to answer these questions when an exact answer is not necessary.

Estimation is important in the process of measurement. When making comparisons in measurement through estimation, children connect number order with number magnitude, forcing children to use terminology of bigger or smaller, longer or shorter, heavier or lighter, etc. (Colmer, 2006). When children estimate before activities they become more invested in the problem solving. Finding the answer to a problem that they initially estimated becomes more meaningful.

When students learn how to estimate they are also learning the following skills according to (Hoffman, 2011):

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

When teaching estimation...

The process of estimation is very diverse, estimating how far it is from here to China and how long it will take for the lasagna to bake are very different. These two estimations

have very little in common, except that, they're both estimates. Therefore we need well chosen activities to teach estimation.

Classifying estimation tasks can be helpful. You can categorize estimation tasks into two categories: real-world context and knowledge of numbers (Booth & Seigler, 2006). Some estimation tasks might require both real-world context and knowledge, such as estimating how far it is from here to China. You would need to be aware of your location and China's location as well as understand the concept of a mile versus 10,000 miles. Other estimation tasks may only include knowledge, but not real-world context, for example, how many jelly beans are in the jar. The process estimating only using knowledge, not real-world context can also be known as pure numerical estimation (Booth & Seigler, 2006). Pure numerical estimation is the process we focus on when teaching young learners about estimation.

There are three important things you should remember when teaching young learners about estimation. First, an estimate is never wrong. An estimate is a guess, the learner cannot be wrong (Colmer, 2006). When teaching estimation recognize that some estimates are better than other, explain that good estimates are close in range, but do not need to be exact answers. To help students reign in their estimates you can agree as a class on limits to their estimations, a low point and a high point within reason. Second, estimation should be useful and practical (Colmer, 2006). Students need to be able to relate to the concept. They should see how they use estimation in their daily life and how people around them use estimation. Third, estimation should be ongoing, fun, and relevant (Colmer, 2006). Be sure to include estimation into your daily classroom activities. Make sure students see that estimation is ongoing. Not all estimation activities need to be formal lessons. Ask students to estimate how long it will take them to finish an activity or estimate how many minutes they will need to get ready for lunch.

### Making Estimation Meaningful

In order to make estimation meaningful there are five components to include in estimation activities (Sousa, 2012). Estimation activities should include purpose, referents, pertinent information, diverse experiences, and range-based techniques. For an estimation activity to have purpose students must have a reason for estimating. Having a purpose gives students a reason to engage in the activity (Sousa, 2012). Referents, otherwise known as benchmarks, help students to succeed. Giving students an example as a point of reference or allowing students to help decide on the point of reference gives them a base as to make their estimate (Sousa, 2012). This is especially helpful for early learners. Pertinent information is essential for making estimation meaningful in the older grades. More experienced estimators should be informed of actual mathematical problems and then decide which type of estimation would be appropriate (Sousa, 2012). Students can help decide whether they should be rounding whole numbers, estimating sums, completing front end estimation, cluster estimation, and more. Diverse

experiences are necessary with all grade levels when teaching estimation. Students should experience different types of estimation in a variety of contexts and content areas. The final component of making estimation meaningful is using range-based techniques. Students should be making predictions within a reasonable range. The goal is to estimate within that range, not to get a precise answer (Sousa, 2012).

## **Objectives**

This unit is intended for students in kindergarten. The students spend most of their day in a self-contained classroom. They only leave for a 45 minute lunch period, a 15 minute recess, and a 45 minute prep class.

The Objectives of this unit include:

- The students will be able to apply one-to-one correspondence to count the number of objects.
- The students will be able to apply the concept of magnitude to compare numbers and quantities.
- The students will be able to classify objects and count objects in each category.
- The students will be able to apply estimation strategies in a variety of situations and contexts.

## **Strategies**

### Think-Pair-Share

Think-Pair-Share is another strategy that will be used. During Think-Pair-Share students will think in their head for several minutes about a question or idea, and then they will turn to the person next to them and share their thoughts. Think-Pair-Share allows for an increase in the quality of student responses. It gives students time to think and respond to questions or prompts. It also relieves the pressure off of students who may be intimidated to respond in front of the whole group. As students are discussing their responses they are also talking out their answers and are able to make better sense of their ideas.

### Activating Prior Knowledge

The teacher will activate prior knowledge through each lesson. Through activating prior knowledge teachers are helping children to connect the text to what they already know. Activating prior knowledge helps students to begin to make connections to the new text they will be reading. When students are able to make connections to text they become more invested in the text they are reading or listening to.

### Graphic Organizers

Students will use graphic organizers throughout this unit. Graphic organizers are a tool that allows students to visually express ideas and concepts. When students use graphic organizers they are able to see undiscovered patterns and relationships that they may not have seen by simply reading or listening to a story. Graphic organizers also help to facilitate conversation about the story and make an excellent reference.

## Modeling

Modeling will be used by the teacher to help convey understanding of new ideas and methods. Modeling is when the teacher demonstrates how to complete different activities by saying aloud the thought process.

## Classroom Activities

### Lesson 1: Introduction to Estimation/Estimating Quantity

*Objectives:* The students will be able to estimate the number of objects in a collection. The students will be able to count objects in a collection. The students will be able to give reasons for their estimates and discuss the results.

#### *Materials:*

- Two jars of the same size
- Candy corn pumpkins
- Post-it notes
- Pencils
- Writing paper

*Procedure:* You will begin by introducing the word *estimate* to your students. Explain to the students that an estimate is a guess that you make using thinking skills and information you already know. Tell students that today we are going to make estimates of how many pumpkin candy corns are in the jar. Show students the first jar containing 10 pumpkin candy corns. Ask the children to think in their head about how many pumpkin candy corns are in the jar. Give students time to think-pair-share (refer to strategies). Then count the pumpkin candy corns as a class. Place all the pumpkin candy corns back in the jar and label the jar with a number 10. Now show the students the next jar of the same size containing more pumpkin candy corns. Tell students that you want to share this jar of pumpkin candy corns with the class, but you aren't sure if you have enough. You want the class to help you make an estimate based on the smaller jar if we'll have enough pumpkins for everyone. Ask students to make estimates of how many pumpkin candy corns are now in this jar. Have students write down their estimates and post them up on the board. As students post their estimates ask them to tell you why they

made that estimate, for example, “I estimated 20 because there is more than 10, since the other jar only had 10, and I can see more in this jar.” As a class count the pumpkin candy corns. Write the number on the jar. Allow students to see if their estimate was close or far away. Do we have enough pumpkins for the class? Have students write to evaluate their answer. For example, “There were 25 pumpkin candy corns. My estimate was 28. My estimate was high than the exact answer. We have enough pumpkins for each child.” You can use the writing paper in the appendix as a guide.

*Extension:* As students become familiar with the estimation process you may have an estimation jar you keep in the classroom where students make estimations throughout the week and on Friday’s the class counts the contents of the jar. This allows for students to see improvements in their estimation skills.

## Lesson 2: Estimating Length

*Objectives:* The students will be able to estimate the length of an object using non-standard units of measurement. The students will be able to give reasons for their estimates and discuss the results. The students will be able to measure using non-standard units of measurement to confirm the answer.

*Materials:*

- Halloween ribbon
- Candy corn
- Pencils
- Post-it notes
- Writing paper

*Procedure:* You will begin by reviewing the word *estimate* to your students. Explain to the students that an estimate is a guess that you make using thinking skills and information you already know. Have student review what you did the day before with estimating quantity. Tell students that today we are going to make estimates of length, estimating how long different Halloween ribbons are. Show students the first ribbon that is 10 candy corns long. Explain to the students that we will be measuring using candy corns. Ask the children to think in their head about how many candy corns long this ribbon is. Show students the direction you will be lining up the candy corn to measure, top to bottom. Model (refer to strategies) your thought process of what it looks like to have one candy corn on the ribbon, how many more candy corn would fit up the ribbon. Give students time to think-pair-share (refer to strategies). Then measure the ribbon as a class counting the candy corns. Label this ribbon with a number 10. Now show the students a longer ribbon. Ask students to make estimates of how many candy corns long this ribbon is. Have students write down their estimates and post them up on the board.

As students post their estimates ask them to tell you why they made that estimate, for example, “I estimated 20 because there is more than 10, since the other ribbon only had 10, and I can see this ribbon is longer.” As a class measure the ribbon using candy corns. Label this ribbon with the correct number of candy corns. Allow students to see if their estimates were close or far away. Have students write to evaluate their answer. For example, “The ribbon was 25 candy corns long. My estimate was 20. My estimate was lower than the exact answer.” You can use the writing paper in the appendix as a guide.

*Extension:* Have students complete the extension activity in the appendix, giving them more practice with measurement estimation.

### Lesson 3: Estimating Area

*Objectives:* The students will be able to estimate the area of different objects. The students will be able to give reasons for their estimates and discuss the results. The students will be able to measure using non-standard units of measurement to confirm the answer.

*Materials:*

- Ghost paper (see appendix)
- Cotton balls
- Paper
- Post-it notes
- Pencils
- Glue
- Writing paper

*Procedure:* You will begin by reviewing the word *estimate* to your students. Ask students to explain what estimate means. Students should be able to tell you that an estimate is a guess that you make using thinking skills and information you already know. Ask students to give examples of estimating. Tell students that today we are going to make estimates about area. Hand out the first half of the paper with the smaller ghost. Explain to students that we will estimate how many cotton balls we will need to cover up our ghost. Give each student one cotton ball to hold and look at. Model (refer to strategies) out loud your thought process of what it looks like to have one cotton ball on the ghost, how many more cotton balls would fit up the ghost. Give students time to think-pair-share (refer to strategies). Then give each student more cotton balls to fill their ghosts. Show students how cotton balls should be touching in fill in the blank area the best you can. Have students label their ghosts with the number of cotton balls it took to fill in the entire area. Now give the students the larger ghosts. Ask students to make

estimates of how many cotton balls you would need to fill the area of the larger ghost. Have students write down their estimates and post them up on the board. As students post their estimates ask them to tell you why they made that estimate, for example, “I estimated 20 because there is more than 10, since the other ghost only had 10, and I can see this ghost is larger.” Then allow each student to fill in their larger ghost with cotton balls. Remind students that the cotton balls should be touching filling in the blank area the best you can. Allow students to see if their estimates were close or far away. Have students write to evaluate their answer. For example, “The large ghost used 30 cotton balls to fill the area. My estimate was 20. My estimate was lower than the exact answer.” You can use the writing paper in the appendix as a guide.

*Extension:*

#### Lesson 4: Estimating Weight

*Objectives:* The students will be able to estimate the weight of different objects using the terms *more* and *less*. The students will be able to give reasons for their estimates and discuss the results. The students will be able to use balancing scales to confirm the answer.

*Materials:*

- Small to medium pumpkins label pumpkins using numbers
- Balancing scales (1 per table of 4 to 5 children)
- Writing paper
- Pencils

*Procedure:* You will begin by reviewing the word *estimate* to your students. Ask students to explain what estimate means. Students should be able to tell you that an estimate is a guess that you make using thinking skills and information you already know. Ask students to give examples of estimating. Tell students that today we are going to make estimates about weight. We will be using balancing scales, so our estimates will not have numbers we will be using the words more and less to describe our estimates. Show the students an example modeling (refer to strategies) the process and telling the students your thoughts. To model you will show students how they will pick two pumpkins to weigh. On their paper they will fill in the first two blanks, “I am going to weight Pumpkin \_\_\_\_ and pumpkin \_\_\_\_.” Then model how you will look at each pumpkin and hold it in your hands to decide which pumpkin you will estimate weighs more. Then when you have made your decision, show students how you will fill in the next sentence, “I estimate pumpkin \_\_\_\_ will weigh more than pumpkin \_\_\_\_ because \_\_\_\_\_.” Then show students how you will weigh the pumpkins on the balancing scale to see which pumpkin weighs more or less to confirm your prediction. Model how

you will complete the last sentence, “My estimate was \_\_\_\_\_.” Students will now have the opportunity at their tables to complete this activity on their own. Remind students that they must take turns and share the pumpkins and balancing scales. Hand-out writing papers (see appendix). Instruct students to write their names at the top first and then they may begin picking their first two pumpkins. They will repeat this activity 4 times. When each table has finished have students discuss their estimates with their tables. During weighing visit each table and observe their estimation and weighing skills, taking anecdotal notes, helping students in need, and encouraging and motivating the class.

*Extension:* Have tables put their pumpkins in order from lightest to heaviest using their information from the estimations and the balancing scales.

## Lesson 5: Estimating Volume

*Objectives:* The students will be able to estimate the volume of different containers. The students will be able to give reasons for their estimates and discuss the results. The students will be able to confirm the answer.

### *Materials:*

- A variety of clear containers (Tupperware containers, small milk jugs, clear cups, etc.). Label each container.
- Dried corn kernels
- Cups of the same size to use for measuring, mark these cups with a special symbol for measuring
- Funnels and scoops
- Large paper plates
- Writing paper

*Procedure:* You will begin by reviewing the word *estimate* to your students. Ask students to explain what estimate means. Students should be able to tell you that an estimate is a guess that you make using thinking skills and information you already know. Ask students to give examples of estimating. Tell students that today we are going to make estimates about volume. Explain to students that we will estimate how many corn kernels we will need to fill each container. Have students work in pairs for this activity. Give each pair of students a measuring cup to look at. Allow each pair of students to fill their measuring cup with corn kernels and observe. We will be estimating how many cups full of corn kernels we can get into the different containers. Model to students how they will complete this activity. First show them how you will pick a container and look at the container inside and outside to estimate how many cups of corn

kernels the container will hold. Then model how to fill in their estimate on the handout. Finally model how students should use their measuring cup to fill the container. Be sure to show students how you need fill the measuring cup all the way to the top before putting it in the funnel to count as one cup. As you pour each cup into the funnel count aloud, then write the correct number of cups next to your estimate on the handout. Before beginning remind students that they need to think about their estimate and take their time. Remind them that corn kernels should stay on the table the best they can. Pass out handouts to students. Have students write their name at the top and then begin. Students will repeat this activity for each container. When each table has finished have students discuss their estimates with their tables. During the activity visit each table and observe student estimations taking anecdotal notes, helping students in need, and encouraging and motivating the class.

Follow-up/Summary:

These lessons can be repeated and reviewed during various themes or for quick activities. Estimation should be something that students can refer to during daily activities. Keeping an estimation station in your classroom can allow for students to practice estimation throughout the year.

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## Teacher Resources:

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## Student Resources:

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## Content Standards

The Core Curriculum of the School District of Philadelphia is aligned to the Pennsylvania Common Core Standards for Mathematics.

2.1.K.A.2 – Apply one-to-one correspondence to count the number of objects.

2.1.K.A.3 – Apply the concept of magnitude to compare numbers and quantities.

2.4.K.A.1 – Describe and compare measureable attributes of objects.

2.4.K.A.4 – Classify objects and count the number of objects in each category.

Appendix

Name: \_\_\_\_\_

## Estimating Length Extension

1.



My estimation: \_\_\_\_\_ candy corns long

The answer is: \_\_\_\_\_ candy corns long

My estimation was \_\_\_\_\_

\_\_\_\_\_.

2.



My estimation: \_\_\_\_\_ candy corns long

The answer is: \_\_\_\_\_ candy corns long

Name: \_\_\_\_\_

# Estimating Pumpkin Weights



1. I am going to weigh pumpkin \_\_\_\_\_ and pumpkin \_\_\_\_\_. I estimate pumpkin \_\_\_\_\_ will weigh more than pumpkin \_\_\_\_\_ because \_\_\_\_\_  
\_\_\_\_\_.

2. I am going to weigh pumpkin \_\_\_\_\_ and pumpkin \_\_\_\_\_. I estimate pumpkin \_\_\_\_\_ will weigh more than pumpkin \_\_\_\_\_ because \_\_\_\_\_  
\_\_\_\_\_.

3. I am going to weigh pumpkin \_\_\_\_\_ and pumpkin \_\_\_\_\_. I estimate pumpkin \_\_\_\_\_ will weigh more than pumpkin \_\_\_\_\_ because \_\_\_\_\_  
\_\_\_\_\_.

Name: \_\_\_\_\_

# Estimating Volume with Corn Kernels



Container	Estimate	Exact
#1	_____ cups	_____ cups
#2	_____ cups	_____ cups
#3	_____ cups	_____ cups
#4	_____ cups	_____ cups
#5	_____ cups	_____ cups
#6	_____ cups	_____ cups
#7	_____ cups	_____ cups
#8	_____ cups	_____ cups
#9	_____ cups	_____ cups
#10	_____ cups	_____ cups

Name: \_\_\_\_\_

# Estimating Area



