It's A Wrap!

NOTES

Logistics: 6th – 8th Grade

Materials:
Per Team of Three or Four Students

- 1-2 – Rolls of Toilet Paper (2-ply with approx. 250 sheets and 4"x4" squares)
- 1 – Hand Template
- 1 – Flexible Measuring Tape
- 1 – Card with the Lateral Surface Area of a Cylinder (*optional*)
- 1 – Strip of Toilet Paper (approx. 3 squares in length)
- Pencils
- Student Pages

Time: 60 minutes

Location: Classroom Setting

Objectives:

- **Students will evaluate the purpose and efficiency of a variety of tools in relation to a mathematical situation.**
- **Students will work collaboratively to determine a solution to a contextual situation.**
- **Students will apply their knowledge of measurement, ratio and proportions to estimate the number of sheets of toilet paper that would be needed to wrap a person.**
- **Students will evaluate how the use of select measuring tools and estimation affects the accuracy of their calculations.**

Standards:

- CCSS.MATH.CONTENT.6.RP.A. *Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.*
- CCSS.MATH.CONTENT.6.RP.A.3.D *Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.*
- CCSS.MATH.CONTENT.7.RP.A.2 *Recognize and represent proportional relationships between quantities.*
- CCSS.MATH.CONTENT.8.G.C.9 *Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.*
- CCSS.MATH.PRACTICE.MP1 *Make sense of problems and persevere in solving them.*

NOTES

- CCSS.MATH.PRACTICE.MP2 *Reason abstractly and quantitatively.*
- CCSS.MATH.PRACTICE.MP3 *Construct viable arguments and critique the reasoning of others.*
- CCSS.MATH.PRACTICE.MP4 *Model with mathematics.*
- CCSS.MATH.PRACTICE.MP5 *Use appropriate tools strategically.*
- CCSS.ELA-LITERACY.CCRA.SL.1 *Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.*
- NGSS.SEP2 *Develop and use models.*
- NGSS.SEP5 *Using mathematics and computational thinking.*

Introduction

The conceptual understanding of measurement and ratio and proportion is an essential principal of middle school mathematics. At this level, students should be presented with a variety of challenges that require mastery and application of these skills. In this activity, students will demonstrate their knowledge of these concepts while engaging in several Common Core Mathematical Practices. In order to truly understand the challenge, students must first ask purposeful questions with the intent of gaining additional information that is required to determine a solution. Then, students will evaluate the appropriateness and accuracy of a variety of measurement tools, and identify which tool is most appropriate for the situation. Finally, students will complete several measurements that will be used to determine the ratios and proportions needed to solve the problem.

Inquiry Overview

This activity will allow students to visually and kinesthetically investigate the concepts of surface area, measurement, and ratio and proportion by engaging in a mathematical investigation. Students will be presented with the challenge of calculating how many sheets of toilet paper it would take to wrap one of their group members. Presented with a variety of measurement tools, students must first evaluate the accuracy and efficiency of each tool, use questioning techniques to gather additional information regarding the specifics of the challenge, and then collaborate with their peers to determine their solution. Students will then have the opportunity to wrap one of their group members and compare their calculated estimate to the actual amount of toilet paper used.

Activity

NOTES

Part I: Investigating the Problem (20 minutes)

Guiding Questions:

- ***What additional information is needed to solve the problem?***
- ***What is the purpose of each tool?***
- ***Which tool would be most appropriate to solve the problem?***

Materials List *per Team*:

- ✓ 1-2 –of Toilet Paper
- ✓ 1 – Hand Template
- ✓ 1 – Flexible Measuring Tape
- ✓ 1 – Card with the Lateral Surface Area of a Cylinder (*optional*)
- ✓ 1 – Strip of Toilet Paper
- ✓ Pencils
- ✓ Student Pages

Suggested Inquiry Approach:
To begin the activity, arrange students into groups of three or four. Provide each student with a copy of the student pages.

Ask for one volunteer to read **The Challenge** statement aloud. Explain to the students that they will eventually have the opportunity to wrap one of their classmates with toilet paper, but first, they must first estimate the number of sheets that would be used. Inform each group to select a person (volunteer) within their group to be wrapped. Ideally, each group should have one volunteer.

Instructor Note: *Teacher discretion should be used in determining how groups are arranged for this activity. Gender-specific seating arrangements would be most appropriate. Additionally, allow students to volunteer to be wrapped. Do not assign students their roles. If one group does not have a volunteer to be wrapped, you may choose to have them switch groups with another person that would volunteer, or have them use data from a neighboring group.*

When students are ready to continue, inform the students that they will use calculations to first estimate the number of sheets of toilet paper that it would take to wrap the group volunteer. However, they have not been provided with a significant amount of information to actually solve the problem.

At this time, give each group several minutes to brainstorm a set of questions that could be asked to gain additional information needed to solve the problem. When all students have finished, allow time for each group to pose their questions.

NOTES

When providing students with answers to their questions, it is important that the instructor avoids providing answers for any questions that the students could determine on their own with the materials they are provided. This encourages the students to critically think and use their materials appropriately.

A list of appropriate questions and answers include:

- **How long is the toilet paper roll?** *Answers will vary based on the brand of toilet paper being used.*
- **How many sheets are in a roll of toilet paper?** *Do not answer this question! Students can use their tools to complete this calculation.*
- **Do you wrap the person with their arms against their body, or stretched out to the sides?** *Allow the students to come to a consensus. Traditionally, the arms are wrapped against the body.*
- **How many layers of toilet paper? Will there be any overlap?** *Traditionally, people are wrapped in one layer of toilet paper with minimal overlap.*
- **How much of the person's body do you have to cover?** *Traditionally, the bottoms of the feet and the eyes are left uncovered.*

Then, inform the students that they have been provided with several tools that they may, or may not, choose to use. Again, allow the students several minutes to investigate their tools and brainstorm a set of questions that could be asked to gain additional information needed to determine a calculated estimate.

The tools and their intended purpose include:

Strip of Toilet Paper *– students can use this tool to measure the length of a sheet, and later use this information to determine how many sheets are included in the toilet paper roll.*

Hand Template *– students can use this tool to determine how many hands cover the individual's body and then determine a mathematical relationship between the length of the hand and the toilet paper squares. Additionally, in the medical field, it is often said that approximately 100 hands will cover the area of a person's body.*

Lateral Surface Area of a Cylinder *– students may identify that a person's body could be represented with a series of cylinders. This resource may or may not be appropriate for your students based on their knowledge of geometric concepts.*

NOTES

Flexible Measuring Tape – *students can use this tool to measure the length of the toilet paper sheets, areas of the body, etc.*

Encourage the students to present their questions. Refrain from providing students with any answers that they could determine on their own.

Part II: Estimation and Calculation (25 minutes)

Guiding Question:

- ***Can students apply the knowledge they gained in Part I to successfully calculate the estimated number of sheets of toilet paper needed to wrap their group member?***

Suggested Inquiry Approach:
Continuing to work in the same groups as in Part I, students will now devise a plan to determine an estimate.

Each group must agree on one method to solve the problem. This may include the use of several tools. The approach to solving the problem must be used by all group members. Then, students will complete all necessary calculations to determine the mathematical relationship between the toilet paper roll and the dimensions of the person being wrapped.

All student work should be recorded on the appropriate student pages. The following mathematical procedure is an example of how students may calculate the estimated of sheets needed to wrap a person:

- Determine the length of a sheet of toilet paper: *Using the toilet paper, it was determined that the length is approximately 4 inches.*
- Determine the number of sheets in a roll: *The toilet paper roll is 73 1/3 feet long. If each sheet is 4 inches, then 3 sheets is equal to 1 foot. There are a total of 220 sheets in the roll.*
- Determine the measurement tool that will be used: *The hand template will be used.*
- What mathematical information can the tool allow you to gain? *After exploration, it was determined that the length of the hand is equal to approximately two toilet paper sheets.*
- Use appropriate mathematical skills to determine a solution (estimate). *Using the theory that approximately 100 hands cover the surface of a body, you can determine that this is equal to 200 sheets (2 sheets: 1 hand = 200 sheets: 100 hands). This is slightly less than one roll.*

NOTES

When it is apparent that all groups have completed their work, allow time for each group to present their estimate along with the method they used. During this time, record this information on the whiteboard or chart paper for students to revisit at the end of the activity. This visual collection of information will allow students to reflect on which method provided a more exact answer, and why.

Debrief Part II:

1.) *Which tool(s) did you choose to work with and why?*
2.) *How did your group use these tools to estimate the number of sheets it will take?*
3.) *Of all the methods discussed, which method(s) do you think will be closest to the exact number of sheets needed? Why? The farthest?*

Part III: Comparison *(15 minutes)*

Guiding Question:

- *Can students compare their estimate to the actual number of sheets used?*

Suggested Inquiry Approach:

Allow time for each group to wrap the selected person(s) with the provided toilet paper. As students are wrapping, it is important for them to remember the number of sheets that are in one roll of toilet paper, so they can keep track of how many are used.

When all groups are finished, they should present the actual number of sheets that were needed. Students can now compare the actual number to their estimate, and consider why their estimate was reasonable or unreasonable. Provide time for each group to discuss their findings.

Debrief Part III:

1.) *How close was your estimate to the actual number needed?*
2.) *What accounted for the difference between these two values?*
3.) *Which measurement devices would provide the most accurate estimation? Why?*
4.) *If you were to do this again, what would you do differently? Why?*

It's A Wrap!

The Challenge: **With your group, determine the number of sheets of toilet paper it would take to completely wrap one of your classmates.**

The Process: **First you will develop a mathematical procedure to estimate the number of sheets of toilet paper that would be needed to completely wrap one of your classmates. Then, you will have the opportunity to actually wrap the individual. Finally, you will compare your estimate to the actual amount that was needed.**

Part I: Investigating the Problem

What questions do you have about the challenge that would be important to ask in order to solve the problem?

Part II: Investigating the Tools

You have been provided with various tools that can be used to assist you in developing your mathematical procedure to estimate the number of sheets of toilet paper. Observe these tools. What questions do you have about the tools that would be important to ask in order to solve the problem?

Your group is responsible for selecting ONE procedure that can be used to estimate the number of sheets of toilet paper needed to wrap one of your classmates. This may, or may not, include the use of multiple tools. After your group comes to a consensus and agrees on how you will determine your estimate, summarize your plan below:

_____

_____

_____

_____

_____

Part III: Determine an Estimate

Using your group's plan, estimate the number of sheets of toilet paper needed to wrap one of your classmates. Show all work below:

Determine the Actual

Wrap your classmate.

How many sheets of toilet paper were needed? _____

How close was your estimate to the actual amount?_____

It’s A Wrap!

Hand Template

It's A Wrap!

Lateral Surface Area of a Cylinder Cards

$2\pi rh$	$2\pi rh$	$2\pi rh$
$2\pi rh$	$2\pi rh$	$2\pi rh$
$2\pi rh$	$2\pi rh$	$2\pi rh$