

# Lesson M1a

## EVACUATE! STARTING UP THE PLANT

MATH TEKS OBJECTIVES	
§111.21 – §111.24	7b.1, 8b.1 (A) apply mathematics to problems arising in everyday life, society, and the workplace
	6b.1, 7b.1, 8b.1 (B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution.
§111.22	6b.1(C) use integers to represent real-life situations
	6b.2 (A) model addition and subtraction situations involving fractions with objects, pictures, words, and numbers
	6b.2 (B) use addition and subtraction to solve problems involving fractions and decimals
	6b.8 (A) estimate measurements (including circumference) and evaluate reasonableness of results
	6b.8 (B) select and use appropriate units, tools, or formulas to measure and to solve problems involving length (including perimeter), area, time, temperature, volume, and weight
	6b.8 (D) convert measures within the same measurement system (customary and metric) based on relationships between units
§111.23	7b.3(A) apply and extend previous understandings of operations to solve problems using addition, subtraction, multiplication, and division of rational numbers
	7b.9(B) determine the circumference and area of circles
§111.24	8b.6(B) model the relationship between the volume of a cylinder and a cone having both congruent bases and heights and connect that relationship to the formulas
	8b.7(A) solve problems involving the volume of cylinders, cones, and spheres
CAREER EXPLORATION AND PORTALS TEKS OBJECTIVES	
§127.3 c	8. The student identifies and explores technical skills essential to careers in multiple occupations, including those that are high skill, high wage, or high demand. The student is expected to: (A) complete actual or virtual labs to simulate the technical skills required in various occupations.

**Instructional Directions** This activity is designed to take 25–45 minutes as presented below.

1. This lesson would follow after students are familiar with formulas for surface area of circle and rectangle.
2. Discuss with students the various preparations needed for an evacuation and what needs to be done when we return from the evacuation. What are some of the things we do at home if we had to leave in an emergency situation? What needs to be done when we return? How do they think their parents might need to prepare at work? If some of your students have parents who work in plants, they may be able to share any knowledge they may have with plant turnarounds.
3. Have students complete **Blackline Master M1a.1** and problem solve how they will determine the surface area of this vessel. Guide them through questioning to find that the vessel is a rectangle and two circles. The height of the vessel is one side of the rectangle and the circumference of the circle is the other side.

**Learning Outcome(s)** Students will be able to use real data to measure, estimate, and hypothesize on real needs and results. Students will determine surface area of a vessel to determine how much cleaning solution is needed to start the plant up again after a shut down and give a cost estimation.

**Related Occupations/Industry** Specialty Construction Industry; Cost Estimator; Energy Industry: Chemical Plant & System Operator; Petroleum Pump System Operators, Refinery Operators, & Gaugers



# Lesson M1a

**Deliverables** Completed Blackline Master M1a.1 and M1a.2

**Resources Needed** • Blackline Master M1a.1 and M1a.2

**IDEAL**

- Integrate actual local business and adapt the lesson to use their actual vessel sizes, metrics, and calculated surface area for the vessels; blue prints or schematics of local plant vessels with all the measurements needed would be useful

**LIMITED**

- Blackline Master M1a.1 and simple data provided on Blackline Master M1a.2

**Vocabulary or Concepts  
(New and/or Challenging)**

- Surface area
- Cost estimation
- Proportions

## MODIFICATIONS & EXTENSIONS

- **Story telling:** bring in occupation representatives to provide depth to scenarios (historical actual scenarios related to hurricane or other emergency evacuations and recovery); students may be asked to interview family, industry experts, or other individuals who have been through a similar scenario and can offer suggestions for other similar calculations to be discovered
- Use algebraic reasoning by removing a unit of measure and having students determine the missing unit; have students determine labor costs; convert units; determine volume of vessel
- **Simplify:** Use only whole numbers with rounding if needed



Name \_\_\_\_\_

Period \_\_\_\_\_

Date \_\_\_\_\_

## EVACUATE! STARTING UP THE PLANT

The Cynergy plant has just allowed its workers to return after a hurricane evacuation. In order to get the plant running again, it needs to clean out some of the vessels. We need to determine how much cleaning solution will be needed to accomplish this task.



1. What formula(s) will we need to use to find the surface area of this vessel?

2. The solution used to clean this vessel uses 1 gallon per 1000 sq.ft. How will we find out how much of the cleaning solution we will need?

3. What will the cost of the cleaning solution be to clean this vessel/drum (Hint: you will need to research costs to solve this.)

Name \_\_\_\_\_

Period \_\_\_\_\_

Date \_\_\_\_\_

## CUSTOMARY UNITS OF MEASURE

This graphic organizer will help you learn about the customary units of measure.

### LENGTH

- inch (width of thumb)
- foot (distance from shoulder to elbow)
- yard (width of classroom door)
- mile (total length of 18 football fields)

### WEIGHT

- ounce (slice of bread)
- pound (loaf of bread)
- ton (small car)

### CAPACITY

- fluid ounce (spoonful)
- cup (glass of juice)
- pint (small bottle of salad dressing)
- quart (small container of paint)
- gallon (large container of milk)

1. Which unit of length is the shortest? \_\_\_\_\_
2. Which unit of weight is lighter than a ton but heavier than an ounce? \_\_\_\_\_
3. Which unit of capacity is the greatest? \_\_\_\_\_
4. Which unit of length is about as long as the distance from your shoulder to your elbow? \_\_\_\_\_
5. Which unit of capacity is about the capacity of a small bottle of salad dressing? \_\_\_\_\_
6. Which unit of weight is about the weight of a small car? \_\_\_\_\_



# Lesson M1b

## EVACUATE! BLOOD JOURNEY

MATH TEKS OBJECTIVES	
§111.21 – §111.24	7b.1, 8b.1 (A) apply mathematics to problems arising in everyday life, society, and the workplace 7b.1, 8b.1 (B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution.
§111.22	6b.1 (C) use integers to represent real-life situations
	6b.2 (A) model addition and subtraction situations involving fractions with objects, pictures, words, and numbers
	6b.2 (B) use addition and subtraction to solve problems involving fractions and decimals
	6b.3 (B) represent ratios and percents with concrete models, fractions, and decimals
	6b.8 (A) estimate measurements (including circumference) and evaluate reasonableness of results
	6b.8 (B) select and use appropriate units, tools, or formulas to measure and to solve problems involving length (including perimeter), area, time, temperature, volume, and weight
	6b.8 (D) convert measures within the same measurement system (customary and metric) based on relationships between units
§111.23	7b.2 number and operations. The student applies mathematical process standards to represent and use rational numbers in a variety of forms. The student is expected to extend previous knowledge of sets and subsets using a visual representation to describe relationships between sets of rational numbers
	7b.3(A) apply and extend previous understandings of operations to solve problems using addition, subtraction, multiplication, and division of rational numbers
CAREER EXPLORATION AND PORTALS TEKS OBJECTIVES	
§127.3 c	8. The student identifies and explores technical skills essential to careers in multiple occupations, including those that are high skill, high wage, or high demand. The student is expected to: (A) complete actual or virtual labs to simulate the technical skills required in various occupations.

### Instructional Directions

This activity is designed to take 25–45 minutes as presented below.

- Using **Blackline Master M1b**, students will use real data to calculate a resource need based on volume. Have students read the prompt at the top of the page and clarify any information needing additional explanation.
- This lesson should follow an introduction to calculating volume, but may also serve as the introduction if paired with existing resources and lessons.
- The data in this lesson is extracted from The American Red Cross website; however, if a local blood bank has similar related information, the teacher is encouraged to modify the lesson with appropriate data as she/he sees fit.

Reference: <http://www.redcrossblood.org/donating-blood>

### Learning Outcome(s)

Students will calculate volume using real data to measure, estimate, or determine resource capacity or need in specific scenarios related to a hurricane evacuation. Specifically, students will measure volume, make inferences, approximate, and hypothesize to determine the amount of blood needed to respond to the emergency scenario following a natural disaster.

### Related Occupations/Industry

Health Care: Medical & Clinical Laboratory Technologists; RNs, LVNs, and Doctors  
Please consult [wrksolutions.com/jobs/focuson.html](http://wrksolutions.com/jobs/focuson.html) for more information.



# Lesson M1b

<b>Deliverables</b>	Completed Blackline Master M1b
<b>Resources Needed</b>	<ul style="list-style-type: none"> <li>• Blackline Master M1b</li> </ul>

## IDEAL

- Integrate Blood Bank with a representative visiting classroom (with a mobile blood unit) or field trip to a blood bank
- Have beakers available to measure out the volume of blood needed per person or taken from a blood donor.

## LIMITED

- Paper-based

## Vocabulary or Concepts (New and/or Challenging)

- Volume
- Pints
- Percent

## MODIFICATIONS & EXTENSIONS

- Story telling of a time when blood was needed or donated
- Find factual information on blood donation: How much blood is in the human body? How much blood is donated per year? How much blood is needed in a year? Who needs donated blood? Blood types? Blood screening? Iron?
- Organize and host your own blood drive
- Play a blood game
  - <http://www.redcrossblood.org/donating-blood/donor-zone/games/blood-type>
  - <http://www.redcrossblood.org/donating-blood/donor-zone/games/find-a-word>
- **Simplify:** Keep all numbers whole numbers, rounding if necessary





## EVACUATE! A TEMPORARY HOME

MATH TEKS OBJECTIVES	
§111.21 - §111.24	<p>7b.1, 8b.1 (A) apply mathematics to problems arising in everyday life, society, and the workplace</p> <p>7b.1, 8b.1 (B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution</p> <p>7b.1, 8b.1 (C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems</p> <p>7b.1, 8b.1 (D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate</p> <p>7b.1, 8b.1 (E) create and use representations to organize, record, and communicate mathematical ideas</p>
§111.22	<p>6b.1 (C) use integers to represent real-life situations</p> <p>6b.2 (A) model addition and subtraction situations involving fractions with objects, pictures, words, and numbers</p> <p>6b.2 (B) use addition and subtraction to solve problems involving fractions and decimals</p> <p>6b.8 (A) estimate measurements (including circumference) and evaluate reasonableness of results</p> <p>6b.8 (B) select and use appropriate units, tools, or formulas to measure and to solve problems involving length (including perimeter), area, time, temperature, volume, and weight</p> <p>6b.8 (D) convert measures within the same measurement system (customary and metric) based on relationships between units</p>
§111.23	<p>7b.2 Number and operations. The student applies mathematical process standards to represent and use rational numbers in a variety of forms. The student is expected to extend previous knowledge of sets and subsets using a visual representation to describe relationships between sets of rational numbers</p> <p>7b.3 (A) add, subtract, multiply, and divide rational numbers fluently</p> <p>7b.3 (B) apply and extend previous understandings of operations to solve problems using addition, subtraction, multiplication, and division of rational numbers</p>
§111.24	<p>8b.1 (F) analyze mathematical relationships to connect and communicate mathematical ideas</p> <p>8b.1 (G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication</p>
CAREER EXPLORATION AND PORTALS TEKS OBJECTIVES	
§127.3 c	<p>8. The student identifies and explores technical skills essential to careers in multiple occupations, including those that are high skill, high wage, or high demand. The student is expected to: (A) complete actual or virtual labs to simulate the technical skills required in various occupations.</p>

**Instructional Directions** This activity is designed to take 45–75 minutes as presented below.

- By applying the content knowledge to a real-life scenario regarding shelter for a hurricane evacuation, students will complete **Blackline Master M1c**.
- This lesson would be best after students understand how to find the surface area of a rectangle. Showing students the floor plan for the Reliant Center would therefore also be helpful. Use the link on the next page to access the images of the floor plan.
- Because the Reliant Center floor is not rectangular, either have students use a best estimate or you may choose to explain and use calculations for composite figures.
- Have students determine what they think the measurement for a good walking space would be between the cots. Because the walking space is an unknown variable at the beginning of the lesson, this will affect the amount of available space for cots. Similarly, if the space from the composite figures are included, more cots may fit in the space.



5. It is up to the teacher to decide how to implement the dimensions desired in the lesson. The worksheet considers the dimensions of Reliant Center.

6. A sample lesson might consider the floor space as a rectangle. An introductory lesson might only consider a portion of the available space at Reliant Park, such as the football field itself.

Here is an interactive and printable diagram of an NFL football field with dimensions:

<http://tinyurl.com/9olez>

An NFL football field measures 360' (L) x 160' (W) or 57,600 sq. ft.

If a cot is 75" x 26" or 1950 sq. in., each cot takes up (approximately) 13.5 sq. ft.

Therefore, lined end-to-end, 4,265 – 4,267 cots would fit in the available space. However, because this would not allow any room for walking in between the cots, how much space do we allow for a walking path and how many cots can we realistically fit in the space?

**Learning Outcome(s)** Students will be able to use real data to measure, estimate, and hypothesize on real needs and results. This lesson should follow lessons M1a and M1b, measuring surface area and volume. Students will practice available resource and cost estimation.

**Related Occupations/Industry** Specialty Construction Industry; Engineer, Cost Estimator, Accountant and Auditor  
Please consult [wrksolutions.com/jobs/focuson.html](http://wrksolutions.com/jobs/focuson.html) for more information.

**Deliverables** Completed Blackline Master M1c

**Resources Needed** Blackline Master M1c  
Floor plans of the Reliant Stadium, Park and Center can be found at:  
<http://reliantpark.com/reliant-stadium>  
Blackline Master M1a.2 can be used as a resource for understanding units of measure.

## MODIFICATIONS & EXTENSIONS

- Use algebraic reasoning by removing a unit of measure and having students determine the missing unit
- School-to-Home Connection (Lesson M1d)
- **Simplify:** Use only whole numbers with rounding if needed

Name \_\_\_\_\_

Period \_\_\_\_\_

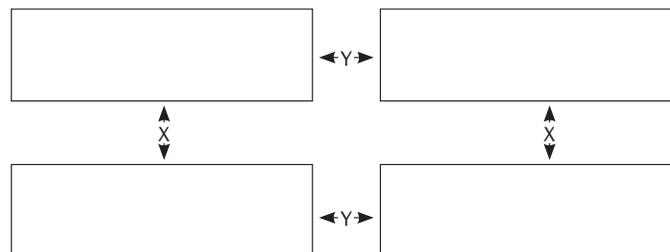
Date \_\_\_\_\_

## EVACUATE! A TEMPORARY HOME

After Hurricane Katrina, many people were displaced because they lost their homes. The Houston community reached out to the victims of this disaster in many ways. One significant contribution the community made was to house the evacuees at the Reliant Center. One challenge was sleeping arrangements.

In an ideal situation, each person would have their own cot. If the floor of the Reliant Center is approximately 706,000 sq. ft. and a cot is 75" L x 26" W x 16" H, how many cots could we fit in this space? Use the box below to sketch the space and write out any necessary calculations.

Now, we need to consider a pathway for the people to walk between cots. Use the diagram below to help you answer the following questions.



1. How much walking space can we allow between cots? \_\_\_\_\_

2. How much available space for cots does this remove? \_\_\_\_\_

3. How many cots will we be able to reasonably fit in the remaining available space? \_\_\_\_\_



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### PLANNING AN EVENT

- The following website gives more detail on the various spaces and space configurations available at the Reliant Center. This additional information can be used to extend the lesson by exploring different uses of space based on what the space is to be used for and how the space is to be used.

[http://reliantpark.com/sites/reliantpark.com/files/ReliantStadiumSpace\\_0.pdf](http://reliantpark.com/sites/reliantpark.com/files/ReliantStadiumSpace_0.pdf)

- Have students plan an event of their choice and determine how the space should be utilized complete with drawings of the various items that will take up space at the event. For example, if they are planning a party in the space, they will need to know how much space each table will take, how many people will be able to sit at each table and therefore how many people can be hosted.
- This project should focus on extending the idea of understanding the use of surface area as it accommodates available resources. However, teachers might encourage creativity in the end product through a demonstration of their event in a presentation, poster, or other demonstrable product.



# Lesson M1e

## EVACUATE! TO EACH THEIR ROLL

MATH TEKS OBJECTIVES	
§111.21 - §111.24	<p>7b.1, 8b.1 (A) apply mathematics to problems arising in everyday life, society, and the workplace</p> <p>7b.1, 8b.1 (B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution</p> <p>7b.1, 8b.1 (C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems</p> <p>7b.1, 8b.1 (D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate</p> <p>7b.1, 8b.1 (E) create and use representations to organize, record, and communicate mathematical ideas</p>
§111.22	<p>6b.1 (C) use integers to represent real-life situations</p> <p>6b.2 (A) model addition and subtraction situations involving fractions with objects, pictures, words, and numbers</p> <p>6b.2 (B) use addition and subtraction to solve problems involving fractions and decimals</p> <p>6b.8 (A) estimate measurements (including circumference) and evaluate reasonableness of results</p> <p>6b.8 (B) select and use appropriate units, tools, or formulas to measure and to solve problems involving length (including perimeter), area, time, temperature, volume, and weight</p> <p>6b.8 (D) convert measures within the same measurement system (customary and metric) based on relationships between units</p>
§111.23	<p>7b.2 number and operations. The student applies mathematical process standards to represent and use rational numbers in a variety of forms. The student is expected to extend previous knowledge of sets and subsets using a visual representation to describe relationships between sets of rational numbers</p> <p>7b.3 (A) add, subtract, multiply, and divide rational numbers fluently</p> <p>7b.3 (B) apply and extend previous understandings of operations to solve problems using addition, subtraction, multiplication, and division of rational numbers</p>
§111.24	<p>8b.1 (F) analyze mathematical relationships to connect and communicate mathematical ideas</p> <p>8b.1 (G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication</p>
CAREER EXPLORATION AND PORTALS TEKS OBJECTIVES	
§127.3 c	<p>8. The student identifies and explores technical skills essential to careers in multiple occupations, including those that are high skill, high wage, or high demand. The student is expected to: (A) complete actual or virtual labs to simulate the technical skills required in various occupations.</p>

**Instructional Direction** This activity is designed to take 30–60 minutes based on chosen depth of activity.

For this lesson, students need to be able to find surface area of a rectangle and calculate measurement conversions.

1. Pass a roll of toilet paper (or several) around the classroom and ask each student to quickly take as much paper off the roll as they would need for a visit to the restroom.
2. Have students follow the **Blackline Master M1e**. If needed, help students measure with a ruler, being sure they understand how to measure accurately.
3. Review area of a rectangle if needed so students can answer question 4.
4. Question 6 on the worksheet would be an opportunity to set up a proportion to calculate the conversion.



# Lesson M1e

5. If possible, have the students take the toilet paper they took from the roll and line the hallway outside the classroom.

<b>Learning Outcome(s)</b>	Students will be able to use real data to measure, estimate, and hypothesize real needs and results. By measuring/calculating surface area and determining how many rolls are needed, they can calculate cost estimations. With this information they can hypothesize the total use and cost of a basic product need during an emergency situation.
<b>Related Occupations/Industry</b>	Specialty Construction Industry; Engineer, Cost Estimator, Accountant and Auditor Please consult <a href="http://wrksolutions.com/jobs/focuson.html">wrksolutions.com/jobs/focuson.html</a> for more information.
<b>Deliverables</b>	Completed Blackline Master M1e
<b>Resources Needed</b>	<ul style="list-style-type: none"> <li>• Blackline Master M1e</li> <li>• 2–3 rolls of toilet paper</li> <li>• Ruler</li> </ul>
<b>Vocabulary or Concepts (New and/or Challenging)</b>	<ul style="list-style-type: none"> <li>• Square feet</li> <li>• Square inches</li> </ul>

## MODIFICATIONS & EXTENSIONS

- Students can take the estimated toilet paper used and roll it out to cover a gym floor. This will help them see how much we use and/or waste.
- Integrate actual local business who manufacture paper/toilet paper to explain to the students the manufacturing, cost, and distribution of their product.
- Integrate a waste management professional to come talk to students about what happens after the flush.
- Have family do activity at home. Discuss ways the family can conserve.
- Bring in occupation representatives to provide depth to scenarios (*historical actual scenarios in which resources were critically limited*)
- Measure in one unit (customary) then convert to another (metric); Measure to nearest  $1/8$ " or  $1/16$ "; extend the lesson to multiple times of use per day and/or over a period of days
- **Simplify:** Use only whole numbers with rounding if needed



Name \_\_\_\_\_

Period \_\_\_\_\_

Date \_\_\_\_\_

## EVACUATE! TO EACH THEIR ROLL

### Instructions:

Quickly take as much toilet paper as you think you might use when you go to the restroom and pass the toilet paper around until everyone has some (careful not to rip it).

- 1.. Count how many individual squares of toilet paper you took and write it here: \_\_\_\_\_
2. Carefully measure one square of toilet paper to the nearest inch. Be sure to measure all sides and record it below.
3. How many square inches of toilet paper did you use?
4. Assume everyone in the classroom used the same amount of toilet paper you did, how many square inches did the class use?
5. How many square feet is that?
6. Now, assume the 27,000 temporary residents of the Reliant Center from hurricane Katrina used the same amount of toilet paper you did, how many square inches of toilet paper would that be? How many square feet would that be?
7. How many rolls of toilet paper would be needed to cover the floor of the Reliant Center (706,000 ft<sup>2</sup>) if each roll covered 275 square feet?