Grade 5
Mathematics
Unit 6: Measurement

Time Frame: Approximately two weeks

Unit Description

The focus of this unit is on time and measurement in both the U.S. and metric systems.

Student Understandings

Students understand the concepts of elapsed time and time zones. They can make conversions of units within the same system for U.S. and metric measurements and make comparisons between the two systems.

Guiding Questions

1. Can students apply the concepts of elapsed time in real-life situations?
2. Can students calculate equivalent times across time zones in real-life situations?
3. Can students convert between units of length, weight/mass, and time measurements within the same systems for U.S. and metric system measurements?

Unit 6 Grade Level Expectations (GLEs) and Common Core State Standards (CCSS)

Grade-Level Expectations	
GLE #	**GLE Text and Benchmarks**
Number and Number Relations	
8.	Use the whole number system (e.g., computational fluency, place value, etc.) to solve problems in real-life and other content areas (N-5-M)
Measurement	
16.	Apply the concepts of elapsed time in real-life situations and calculate equivalent times across time zones in real-life problems (M-1-M) (M-6-M)
23.	Convert between units of measurement for length, weight, and time, in U.S. and metric, within the same system (M-5-M)
CCSS for Mathematical Content	
CCSS#	**CCSS Text**
Number and Operations in Base Ten	
5.NBT.1	Recognize that in a multi-digit number, a digit in one place is 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.
5.NBT.5	Fluently multiply multi-digit whole numbers using the standard algorithm

Writing Standards	
W.5.2a	Write informative/explanatory texts to examine a topic and convey ideas and information clearly. a. Introduce a topic clearly, provide a general observation and focus, and group-related information logically; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.

Sample Activities

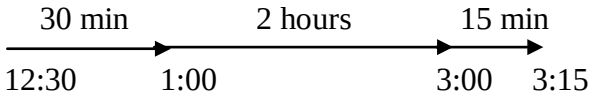
Activity 1: Elapsed Time (GLEs: 16)

Materials List: paper, pencils, clocks with movable hands

Using an actual class schedule, model problems of elapsed time. If clocks with moveable hands are not available for each pair of students, model with one or two clocks. Examples: If it is 9:30 A.M. and lunch is at 11:20 A.M., how much time will pass between the two times? If it is 12:30 and school ends at 3:15, how much time is left in the school day? Using the clock, show the hands moving while counting out loud. "It is 1 hour from 12:30 to 1:30, two hours to 2:30, 30 minutes to 3:00, and 15 more minutes to 3:15. This is one hour, two hours, thirty, forty-five minutes. It is two hours and forty-five minutes until the school day ends." (Have students estimate times, such as it's about three hours until the school day ends.) Ask questions such as this: Is 1 hour a reasonable amount of time remaining in the school day? Give various times so students can find the amounts of time elapsed.

Consider showing elapsed time on an open number line. An open number line is a number without any numbers initially. Students are allowed to choose the numbers to place on the number line. The intervals do not have to be evenly spaced, but should be proportional to the length of time.

To show elapsed time from 12:30 to 3:15, use a number line similar to this and say,



"From 12:30 to 1:00 is 30 minutes, from 1:00 to 3:00 is 2 hours, and from 3:00 to 3:15 is 15 minutes. The school day ends in 2 hours and 45 minutes." Ask if anyone would have used an open number line in a different way. Some students might jump 10 minutes from 12:30 to 12:40 to 12:50 to 1:00. This would still give them an initial amount of time of 30 minutes. Other students might jump the hours first and then the minutes. Students are allowed to choose the jumps that make sense to them. The amount of time elapsed will be

the same. Students will not have access to clocks with movable hands for testing, and they need to be shown other strategies.

Activity 2: How Long Does It Take? (GLEs: 16; CCSS: W.5.2a)

Materials List: paper, pencils, clocks with movable hands

Have students work in pairs. Each student will need a clock face with movable hands. (If these are not available, have at least 2 clocks for demonstration.) The night before, have students time an activity, such as watching a movie or playing a computer game, to the nearest minute. Ask students to record the type of activity, the starting time, and the ending time. Have one student share his/her information with the rest of the class. Instruct the first student in each pair to show the starting time and the second student to show the ending time. Have the students estimate the amount of time it took to do the activity. Ask the students to discuss how they could move the hands on one of the clocks to find the amount of time that passed, or elapsed, to get the second time. Continue using different activities and times. Once students are comfortable with finding the elapsed time, give students a starting time and the amount of time it would take to do the activity. Ask them to find the ending time and to discuss how they found it. Re-introduce the open number line model from Activity 7.

Use math *text chains* (view literacy strategy descriptions) to practice elapsed time. The first student writes the opening sentence of the problem, as in the example below.

The party started at 4:45 P.M.

The student passes the paper to the student sitting to the right. That student writes the next sentence.

The party was over at 6:15 P.M.

The paper is passed again to the right. This student writes the question for the text.

How long was the party?

The paper is now passed to the fourth student who must solve the problem, write the answer in a complete sentence, and discuss how the answer was found.

Answer: The party was 1 hour 30 minutes long.

Students in the *text chain* group should talk about the accuracy of the answer and the logic of the text problem. If necessary, revisions to the *text chain* should be made.

Activity 3: Planning a Trip (GLEs: 8, 16; CCSS: 5.NBT.5)

Materials List: paper, pencils, Internet access

Making schedules are a good way to help students practice elapsed time. Go to http://illuminations.nctm.org/LessonDetail.aspx?ID=U115, *Planning a Trip*. In this activity, groups of 4 students plan trips and make a travel schedule and a budget for their trip. The activity involves elapsed time. Making the budget will provide a review of operations on whole numbers.

When students have completed their travel schedule and planned their budget, have them demonstrate their understanding of their activity by completing a *RAFT writing* (view literacy strategy descriptions) assignment. This form of writing gives students the freedom to project themselves into unique roles and to look at content from unique perspectives and, when crafted appropriately, should be creative and informative.
R – Role (role of the writer – travel agent)
A – Audience (to whom the *RAFT* is being written – customer who could potentially book the trip you planned)
F – Form (the form the writing will take – a letter)
T – Topic (the subject of the focused writing – to formally explain the planned trip and tell why it would be the most economical choice.)
The groups should share their writing with the class. Students should listen for accuracy and logic in each *RAFT*.

Activity 4: Time Zone Math (GLE: 16)

Materials List: paper, pencils, The Internet **(**optional)

Using a time zone map, review with students the need for the different time zones across the United States. Most 5th grade textbooks have time zone maps in them. If not, maps can be found online at sites, such as www.time.gov, www.WorldAtlas.com, www.worldtimezone.com. Ask questions such as this: If the sun is rising at 6 A.M. on the East coast, what time is it on the West coast? Have students *brainstorm* (view literacy strategy descriptions) to find examples of events that will have different starting times because of the location of the event. For example, if an awards ceremony is shown in New York at 8 P.M., what time will it be shown in California? A football game that is broadcast at noon in the Central time zone actually begins at 1 P.M. in the Eastern time zone. When students grasp this concept, have them work simple problems involving duration of and arrival time for flights. For example, if it takes 3 ½ hours to fly from New York to New Orleans, what time will the plane arrive in New Orleans if it leaves New York at 2 P.M.? (4:30 P.M.)

Have students create simple word problems across time zones. Ask volunteers to share their problems with the class and have them checked for accuracy. An extension of this activity would be to use airlines' flight schedules. Have students determine the number of flying hours/minutes from city to city using times within the same time zone and between different time zones.
Websites, such as www.orbitz.com, www.expedia.com, or any of the major airlines, have online flight schedules and information.

Activity 5: Getting Ready for Conversions (GLE: 23; CCSS: 5.NBT.1, 5.NBT.5)

Materials List: paper, pencils, calculator for each pair of students

When students make conversions in the metric system, they will need to multiply and divide by 10, 100, and 1000. Have students work in groups and provide at least one calculator per two students. If available, model the problems on an overhead calculator. Have students multiply any three numbers by 10. Have students call out one of their problems, such as $23 \times 10 = 230$. After about 5 examples, see if students can find a pattern to multiplying by 10. The place value of each digit in the number shifts one place to the left.

- If 2,450 is multiplied by 10, the value of the 2 that was in the thousands place is no longer 2000. The value increased to 10×2000 or 20,000. The digit 2 is in the ten-thousands place of the product.
- The value of the 4 that was in the hundreds place is no longer 400. The value has increased to 10×400 which is equal to 4,000. The digit 4 is in the thousands place of the product.
- The value of the 5 that was in the tens place is no longer 50. The value has increased to 10×50 which is equal to 500. The digit 5 is in the hundreds place of the product.
- The digit in the ten's place is zero because 10×0 is equal to 0.
- The new digit in the one's place is zero.
- The multiplier 10 has one zero, so multiplying by 10 shifts all of the digits one place to the left. The new number becomes 24,500.

Do the same activity multiplying 2,450 by 100 and then by 1,000.

For division, the shift is now to the right.

- If 2450 is divided by 10, the value of the 2 that was in the thousands place is no longer 2000. The value has decreased to $2000 \div 10$ which is equal to 200. The digit 2 is in the hundreds place of the product.
- The value of the 4 that was in the hundreds place is no longer 400. The value has decreased to $400 \div 10$ which is equal to 40. The digit 4 is in the tens place of the product.
- The value of the 5 that was in the tens place is no longer 50. The value has decreased to $50 \div 10$ which is equal to 5. The digit 5 is in the ones place of the product. The new number becomes 245.
- The divisor 10 has one zero, so dividing by 10 shifts all of the digits one place to the right.

Have students do the same activity dividing 2450 by 100 and then by 1,000.

Activity 6: Conversions (GLEs: 23; CCSS: 5.NBT.5)

Materials List: Conversions BLM, pencils, linear measuring tools, calculator, 2 strips of paper – one 1 in. long and the other 1 ft long

One of the problems that students have with conversions is not knowing when to multiply or when to divide. Hold up a strip of paper that is 1 in. long and a strip that is 1 ft. long. Ask: If you were to measure the length of the room, would it take more "inch" strips or more "foot" strips? *(inch strips)* Why? *(Inches are smaller units, so you need more.)* Students need to understand that the smaller the unit, the more of that unit they will need. Since inches are smaller than feet, more inches than feet will be needed when measuring an object. To change from a smaller unit to a larger unit, students should divide so that they get fewer of the larger unit.

Have each group of students choose a linear object to measure. Make sure that the objects selected are longer than 1 yard. Distribute the Conversions BLM. Have them measure the object to the nearest inch, foot, and yard. Display a chart such as the one below, and have students record their measurements on the Conversions BLM.

Object Measured	Inches	Feet	Yards

As the objects are measured and the measurements are listed, ask students questions such as these: Why do you have larger numbers in the Inches column than in the Feet column? When you measured your object, did you get more feet or more yards? Why do you think this happened? Remind students that the actual measurements are approximate. Observe any patterns in the tables they find. Have students use a calculator to divide the number of inches by 12. This number should be close to the number of feet. Another option would be to have them multiply the number of feet by 12 to get the number of inches. Have them divide the number of feet by 3. This number should be close to the number of yards. Students should begin to see that 1 foot = 12 inches, and that 1 yard = 3 feet. Repeat the activity using millimeters, centimeters, and meters. Students should understand that 10 mm = 1 cm, 100 cm = 1 m and 1000 mm = 1 m. Ask the same types of questions as above. Compare the number of yards and meters for each object, and the number of inches and centimeters for each object. Have students share their comparisons with the class.

Activity 7: Tables of Conversions (GLEs: 8, 23; CCSS: 5.NBT.5)

Materials List: Tables of Conversions BLM, pencils

Provide students with the Tables of Conversions BLM. Focus on the conversions for one attribute each day. For example, for the attribute time, begin by asking if you measure the school year in days or months, would you have a larger number of days or a larger number of months? *(days)* Why? *(Days are smaller units than months.)* Give real-world

problems such as this one. If Steve practiced football 6 days this week for 50 minutes a day, or 300 minutes, how many hours did he practice this week? Have students think equivalent ratios or make a table.

60 min = 1 hr
120 min = 2 hrs
240 min = 4 hrs
300 min = 5 hrs

Students may go from thinking 60 min = 1 hr to 120 min = 2 hrs or they may think that there are five 60's in 300, so that would be 5 hours. Using equivalent ratios will work even if the numbers do not divide evenly.
Ask students, "If it takes 250 minutes to bake a turkey, how many hours is that?

60 min = 1 hr
120 min = 2 hrs
240 min = 4 hrs, but you have 250 minutes. So the numbers of hours is 4 hrs and 10 minutes left over.

Students could also set up equivalent ratios like this. For the question, how many inches are in 6 feet, students could write the following:
1 ft = 12 in.
6 ft ? in.
What number would replace the box? *(72)* Why? *(12/72 is equivalent to 1/6)*

Continue asking students to convert from one unit to another. Using ratios or making a table helps with the decision of whether to multiply or divide.

Activity 8: If You Made a Million (GLEs: 23; CCSS: 5.NBT.5, W.5.2a.)

Materials List: paper, pencils, *If You Made a Million*, pennies, rulers

Read the book *If You Made a Million* to students. There are wonderful opportunities for measurement in it. After reading the book, provide students with an *SQPL* (view literacy strategy descriptions) activity by displaying this statement: "The book states that 'You can have a five-foot stack of pennies (that's one thousand of them…).' Therefore, a five-foot stack of pennies would equal 1000 pennies." Through *SQPL writing*, the students will become engaged in the lesson by creating and then answering their own unique questions about the content they are learning. Because these are student-generated questions, the students are more inclined to pay close attention to the information source to answer their questions. This strategy is beneficial in assisting students in creating questions they would need to verify the statement. Working in groups of four, have students *brainstorm* (view literacy strategy descriptions) 2 or 3 different questions. Students might ask questions such as: How many pennies are in one inch? (Students can measure this.) How many inches are in one foot? Have groups present one of their

questions to the class. Reread the statement. Have students answer the questions and decide if the statement is true. The book is also a great way to review whole numbers.

Sample Assessments

General Assessments

- Portfolio assessments could include the following:
  - Anecdotal notes made during teacher observation
  - Any of the journal entries, or one of the explanations from the specific activities
  - Corrections to any of the missed items on the tests
- On any teacher-made written tests, include the following.
  - A problem that requires the student to explain his/her reasoning when answering the following question: When changing from one unit of measurement to another unit, explain whether you should multiply or divide. Give an example to support your statement.
- Journal entries could include the following:
  - Explain the process used to change 4 yards into inches.
  - Explain your reasoning: Joanie talked on the phone for 1 hour. Ted talked for 65 minutes and Byron talked for 355 seconds. Who talked the longest? How do you know?

Activity-Specific Assessments

- Activity 1: Give students a starting time and an ending time for an activity, and have them find the elapsed time. Then give students a starting time, the elapsed time and have them find the ending time. Use real-world events to keep students interested.

- Activity 4: Give students the following chart:

Time Zones	
Pacific Time Zone	9:00 A.M
Mountain Time Zone	10:00 A.M
Central Time Zone	11:00 A.M
Eastern Time Zone	12:00 Noon

  Have students use the chart to answer the following questions:
  - You live in the Central Time Zone and want to check on an order from a company in the Pacific Time Zone. Their closing time is 6:00 P.M. Can you call at 5:00 P.M. your time? Explain your reasoning? (A call at 5:00 P.M. in the Central Time Zone would be equivalent to a call at 7:00 P.M. in the Pacific Time Zone. The business would be closed.)

- What is the time difference between Pacific Time and Eastern Time? (3 hours)
- If it is 10:00 A.M. in Baton Rouge, what time is it in Denver? (9:00 A.M. Denver is in Mountain Time Zone and Baton Rouge is in Central Time Zone.)

- Activity 6: Have students solve the following problem: Mr. Baffled Builder began cutting lumber for a large tree house. Half-way through the process, he noticed the lengths of certain boards didn't look right. "My conversions are off," he exclaimed, "but I don't know why." Help Mr. Baffled Builder make the correct conversions to build the tree house by explaining what he did wrong.

Conversions needed	**Conversions Mr. Baffled Builder made**
300 centimeters to meters	30 meters
1 meter to centimeters	10 centimeters
20 millimeters to centimeters	200 centimeters

(Correct conversions: 300 centimeters = 3 meters, 1 meter = 100 centimeters, 20 millimeters = 2 centimeters)