SOUTH CAROLINA SUPPORT SYSTEMS INSTRUCTIONAL GUIDE

Content Area	2nd Grade Math
Recommended Days of Instruction	4th Nine Weeks

Standard 2-2: The student will demonstrate through the mathematical processes an understanding of the base-ten numeration system; place values; and accurate, efficient, and generalizable methods of adding and subtracting whole numbers.
2-2.5: Interpret models of equal grouping (multiplication) as repeated addition and arrays. (B2)
2-2.6: Interpret models of sharing equally (division) in as repeated subtraction and arrays. (B2)
2-2.10 Analyze the magnitude of digits through 9,999 on the basis of their place value.

Standard 2-3: The student will demonstrate through the mathematical processes an understanding of numeric patterns and quantitative and qualitative change.
2-3.4: Identify quantitative and qualitative change over time. (B1)
2-3.5: Analyze quantitative and qualitative change over time. (B4)

Standard 2-5: The student will demonstrate through the mathematical processes and understanding of the value of combinations of coins and bills and the measurement of length, weight, time, and temperature.
2-5.3 Use appropriate tools to measure objects to the nearest whole unit: measuring length in centimeters, feet, and yards; measuring liquid volume in cups, quarts, and gallons; measuring weight in ounces and pounds; and measuring temperature on Celsius and Fahrenheit thermometers.
2-5.7 Use analog and digital clocks to tell and record time to the nearest quarter hour and to the nearest five-minute interval.
2-5.8 Match a.m. and p.m. to familiar situations.

Standard 2-6: The student will demonstrate through the mathematical processes an understanding of creating questions to collect data, organizing data, describing trends of a data set, and making predictions based on data.
2-6.3: Infer trends in a data set as increasing, decreasing, or random. (B2)
2-6.4: Predict on the basis of data whether events are *more likely* or *less likely* to occur. (B2)

* These indicators are covered in the following 4 Modules for this Nine Weeks Period.
Teaching time should be adjusted to allow for sufficient learning experiences in each of the modules.

Module 4-1 Year Long Indicators			
Indicator	**Recommended Resources**	**Suggested Instructional Strategies**	**Assessment Guidelines**
Module 1-1 Lesson A 2-2.10 Analyze the magnitude of digits through 9,999 on the basis of their place values. (B4)	**STANDARD SUPPORT DOCUMENT** http//:www.ed.sc.gov/apps/cso/standards NCTM's Online Illuminations http://illuminations.nctm.org NCTM's Navigations Series Teaching Student-Centered Mathematics Grades K-3 and Teaching Elementary and Middle School Mathematics Developmentally 6th Edition, John Van de Walle NCTM's Principals and Standards for School Mathematics (PSSM)	See Instructional Planning Guide Module 1-1 Introductory Lesson A See Instructional Planning Guide Module 1-1, Lesson A Additional Instructional Strategies	See Instructional Planning Guide Module 1-1 Lesson A Assessing the Lesson
Module 1-1 Lesson B 2-5.3: Use appropriate tools to measure objects to the nearest whole unit: measuring length in centimeters, feet, and yards; measuring liquid volume in cups, quarts, and gallons; measuring weight in ounces and pounds; and measuring temperature on Celsius and Fahrenheit thermometers. (C3) 2-5.7 Use analog and digital clocks to tell and		See Instructional Planning Guide Module 1-1 Introductory Lesson B	See Instructional Planning Guide Module 1-1 Lesson B Assessing the Lesson

record time to the nearest quarter hour and to the nearest five-minute interval. (C3) 2-5.8 Match *a.m.* and *p.m.* to familiar situations. (A2)			
Module 1-1 Lesson C 2-5.3: Use appropriate tools to measure objects to the nearest whole unit: measuring length in centimeters, feet, and yards; measuring liquid volume in cups, quarts, and gallons; measuring weight in ounces and pounds; and measuring temperature on Celsius and Fahrenheit thermometers. (C3)		See Instructional Planning Guide Module 1-1 Introductory Lesson C See Instructional Planning Guide Module 1-1, Lesson C Additional Instructional Strategies	See Instructional Planning Guide Module 1-1 Lesson C Assessing the Lesson
Module 4-2 Data Analysis and Probability			
Indicator	**Recommended Resources**	**Suggested Instructional Strategies**	**Assessment Guidelines**

Module 4-2 Lesson A 2-6.4: Predict on the basis of data whether events are *more likely* or *less likely* to occur. (B2)	**STANDARD SUPPORT DOCUMENT** http//:www.ed.sc.gov/apps/cso/standards NCTM's Online Illuminations http://illuminations.nctm.org NCTM's Navigations Series	See Instructional Planning Guide Module 4-2 Introductory Lesson A	See Instructional Planning Guide Module 4-2 Lesson A Assessing the Lesson

Module 4-2 Lesson B 2-6.3: Infer trends in a data set as increasing, decreasing, or random. (B2)	Teaching Student-Centered Mathematics Grades K-3 and Teaching Elementary and Middle School Mathematics Developmentally 6th Edition, John Van de Walle NCTM's Principals and Standards for School Mathematics (PSSM)	See Instructional Planning Guide Module 4-2 Introductory Lesson B	See Instructional Planning Guide Module 4-2 Lesson B Assessing the Lesson
Module 4-3 Qualitative and Quantitative Change			
Indicator	**Recommended Resources**	**Suggested Instructional Strategies**	**Assessment Guidelines**

Module 4-3 Lesson A 2-3.4: Identify quantitative and qualitative change over time. (B1) 2-3.5: Analyze quantitative and qualitative change over time. (B4)	**STANDARD SUPPORT DOCUMENT** http//:www.ed.sc.gov/apps/cso/standards NCTM's Online Illuminations http://illuminations.nctm.org NCTM's Navigations Series Teaching Student-Centered Mathematics Grades K-3 and Teaching Elementary and Middle School Mathematics Developmentally 6th Edition, John Van de Walle NCTM's Principals and Standards for School Mathematics (PSSM)	See Instructional Planning Guide Module 4-3 Introductory Lesson A See Instructional Planning Guide Module 4-3, Lesson A Additional Instructional Strategies	See Instructional Planning Guide Module 4-3 Lesson A Assessing the Lesson

Module 4-4 Multiplication and Division			
Indicator	**Recommended Resources**	**Suggested Instructional Strategies**	**Assessment Guidelines**
Module 4-4 Lesson A 2-2.5 Interpret models of equal grouping (multiplication) as repeated addition and arrays. (B2)	**STANDARD SUPPORT DOCUMENT** http//:www.ed.sc.gov/apps/cso/standards NCTM's Online Illuminations http://illuminations.nctm.org NCTM's Navigations Series	See Instructional Planning Guide Module 4-4 Introductory Lesson A	See Instructional Planning Guide Module 4-4 Lesson A Assessing the Lesson

Module 4-4 Lesson B **2-2.6** Interpret models of sharing equally (division) in as repeated subtraction and arrays. (B2)	Teaching Student-Centered Mathematics Grades K-3 and Teaching Elementary and Middle School Mathematics Developmentally 6th Edition, John Van de Walle NCTM's Principals and Standards for School Mathematics (PSSM)	See Instructional Planning Guide Module 4-4 Introductory Lesson B	See Instructional Planning Guide Module 4-4 Lesson B Assessing the Lesson

MODULE

4-1

Year Long Math Indicators

This module addresses the following indicators:

2-2.10: Analyze the magnitude of digits through 9,999 on the basis of their place values. (B4)

2-5.3: Use appropriate tools to measure objects to the nearest whole unit: measuring length in centimeters, feet, and yards; measuring liquid volume in cups, quarts, and gallons; measuring weight in ounces and pounds; and measuring temperature on Celsius and Fahrenheit thermometers. (C3)

2-5.7: Use analog and digital clocks to tell and record time to the nearest quarter hour and to the nearest five-minute interval. (C3)

2-5.8: Match *a.m.* and *p.m.* to familiar situations. (A2)

These indicators were first introduced in Module 1-1, 1st nine weeks. These indicators should be revisited all year long. **See notes for revisiting in this module. There will not be actual lessons in this module, rather teachers should read the teacher notes and refer to module 1-1 as the building blocks.** These lessons are **INTRODUCTORY ONLY**. Lessons in S3 begin to build the conceptual foundation students need. **ADDITIONAL LESSONS will be required** to fully develop the concepts.

I. Planning the Module

The first bullet under the Continuum of Knowledge represents students prior knowledge and/or skills related to this standard. It is recommended that students are pre-assessed on this prior knowledge.

Continuum of Knowledge

2-2.10 Analyze the magnitude of digits through 9,999 on the basis of their place value.

- In kindergarten, the students analyze the magnitude of digits through 99 on the basis of their place values. (K-2.6). In first grade, students analyze the magnitude of digits through 999 on the basis of their place values. (1-2.9)
- In second grade, students analyze the magnitude of digits through 9,999 on the basis of their place values. (2-2.10)
- In third grade students, analyze the magnitude of digits through 999,999 on the basis of their place values. (3-2.12)

2-5.3 Use appropriate tools to measure objects to the nearest whole unit: measuring length in centimeters, feet, and yards; measuring liquid volume in cups, quarts, and gallons; measuring weight in ounces and pounds; and measuring temperature on Celsius and Fahrenheit thermometers.

- Kindergarten students use nonstandard units to explore the measurement concepts of length and weight. (K-5.3). In first grade, students use whole inch units to measure the length of an object (1-5.4).
- Second grade students use appropriate tools to measure objects to the nearest whole unit measuring length in centimeters, feet, and yards; measuring liquid volume in cups, quarts, and gallons; measuring weight in ounces and pounds; and measuring temperature on Celsius and Fahrenheit thermometers. (2-5.3)
- Third grade students use appropriate tools to measure objects to the nearest unit: measuring length in meters and half inches; measuring liquid volume in fluid ounces pints, and liters; and measuring mass in grams. (3-5.2)

2-5.7 Use analog and digital clocks to tell and record time to the nearest quarter hour and to the nearest five-minute interval.

- Kindergarten students used analog and digital clocks to tell time to the hour. (K-5.6) First grade students used analog and digital clocks to tell and record time to the hour and half-hour. (1-5.8)
- In second grade, students use analog clocks to tell and record time to the nearest quarter hour and to the nearest five minute interval. (2-5.7)

- Third grade students will use analog and digital clocks to tell time to the nearest minute. (3-5.5)

2-5.8 Match a.m. and p.m. to familiar situations.

- This standard is not addressed at the Kindergarten or first grade level.
- Second grade students will match a.m. and p.m. to familiar situations. They also use analog and digital clocks to tell and record time to the nearest quarter hour and to the nearest five-minute interval (2-5.7)
- In third grade, students use analog and digital clocks to tell time to the nearest minute (3-5.6).

Key Concepts/Key Terms

*These are vocabulary terms that are reasonable for students to know and be able to use. Terms without the * are additional terms for teacher awareness, knowledge and use in conversation with students.

- *digits
- *Place value
- *Value
- *Units/ones
- *Tens/rods
- *Hundreds/flats
- *Thousands/cube
- *Standard form
- *Expanded form
- *Compose/decompose
- *Equivalent forms
- *Measure
- *Unit
- *Ruler
- *Centimeter
- *Feet
- *Yard
- *Liquid volume
- *Cup
- *Quart
- *Gallon
- *Weigh
- *Weight
- *Ounces
- *Pounds
- *Temperature
- *Thermometer
- *Fahrenheit
- *Celsius
- *Degrees
- *Length
- *Analog
- *Digital
- *Time
- *Clock
- *Hour
- *Half-hour
- *Quarter hour
- *Minute
- *Interval
- *A.M./ a.m.
- *P.M./ p.m.

Teacher Notes: Mathematics learning builds over the course of time. This is especially true with concepts such as number sense; equivalencies; weight, linear, and liquid measurement; time; money, just to name a few. As a result some topics are best acquired through repeated exposure in small on-going intervals of time. Therefore, while an introductory lesson has been provided for the concepts addressed in Module 1-1, First Nine Weeks, it is important to point out that students will need on-going formal and informal experiences throughout the year to ensure the automaticity and flexibility that is demonstrated with mathematical understanding.

Second grade students should continue to use concrete and pictorial materials to build understanding on the concepts addressed in Module 1-1, First Nine Weeks, for these year long indicators. Please refer to this Module and provide learning experiences that builds on prior learning to meet the indicators. Use the *Additional Instructional Strategies/Differentiation Variations* to gradually increase the capacity and allow student understanding to develop through repeated exposure.

MODULE

4-2

Data Analysis And Probability

This module addresses the following indicators:

2-6.3: Infer trends in a data set as increasing, decreasing, or random. (B2)

2-6.4: Predict on the basis of data whether events are *more likely* or *less likely* to occur. (B2)

This module contains 2 lessons. These lessons are **INTRODUCTORY ONLY**. Lessons in S3 begin to build the conceptual foundation students need. **ADDITIONAL LESSONS will be required** to fully develop the concepts.

I. Planning the Module

The first bullet under the Continuum of Knowledge represents students prior knowledge and/or skills related to this standard. It is recommended that students are pre-assessed on this prior knowledge.

Continuum of Knowledge

2-6.3: Infer trends in a data set as increasing, decreasing, or random. (B2)

- In kindergarten, students interpreted data from a graph. (K-6.2) In first grade, students interpreted data in picture graphs, object graphs, bar graphs, and tables by using the comparative terms more, less, greater, fewer, greater than, less than. (1-6.3)
- In second grade, students infer trends in a data set as increasing, decreasing, or random. (2-6.3)
- In third grade, students interpret data in tables, bar graphs, pictographs, and dot plots. (3-6.3)

2-6.4: Predict on the basis of data whether events are *more likely* or *less likely* to occur. (B2)

- In first grade, students predicted on the basis of data whether events are likely or unlikely to occur. **(1-6.4)**
- In second grade, students predict on the basis of data whether events are *more likely* or *less likely* to occur. **(2-6.1)**
- In third grade, students predict on the basis of data whether events are *likely*, *unlikely*, *certain*, or *impossible* to occur. **(3-6.6)**

Key Concepts/Key Terms

**These are vocabulary terms that are reasonable for students to know and be able to use. Terms without the * are additional terms for teacher awareness, knowledge and use in conversation with students.*

*Data
*Data set
*Increasing
*Decreasing
*Random
*Trends in a data set
*Infer
*Events
*More likely
*Less likely
*Occur
*Predict

II. Teaching the Lesson(s)

1. Teaching Lesson 4-2A Prediction; More Likely or Less Likely

2-6.4: Predict on the basis of data whether events are *more likely* or *less likely* to occur. (B2)

For this indicator, it is **essential** for students to
- predict on the basis of data whether events are more likely or less likely to occur.
- understand the meaning of more and less.

For this indicator, it is **not essential** for students to
- predict on the basis of data whether events are likely, unlikely, certain, or impossible to occur.

a. Indicators with Taxonomy

2-6.4: Predict on the basis of data whether events are *more likely* or *less likely* to occur. (B2)
Cognitive Process Dimension: Understand
Knowledge Dimension: Conceptual Knowledge

b. Introductory Lesson

Lesson adapted from Navigating through Data Analysis and Probability in Prekindergarten-Grade 2: NCTM Navigations Series: Morley Most and Lutie Least pp 36-40

Materials:
Sticky notes
Newsprint
Markers

Lesson:

Write on the top of the Newsprint "Writing Hands". On the bottom of the paper, write "Right Left Both" leaving enough space so that the students can place sticky notes above the words.

Ask the students: What is the title of this graph? What might that stand for? Tell them that they are going to make a graph that illustrates what hand everyone writes with. Ask: What are the categories? Have them draw a hand on the sticky note with a thumb to the right if they write with their right hand, a thumb on the left side if they write with their left hand, or a thumb on both sides if they write with both hands. Then have them bring them up one at

a time and place them over the correct label. Explain to them the importance of placing them one on top of each other so that there is no space in between and they are not overlapping. When they finish, it should look like a bar graph. If it is hard for them to do this, draw squares on the paper first. Number the side of the graph to label the number of sticky notes.

Ask:

- Do more people write with their left hand or their right hand?
- How many more people write with the right hand?
- How do you know?
- How many people can write with both hands?
- Suppose that one person in your class is chosen to write on the board. Which hand do you think the student will use to write? Explain your choice.
- If someone from another class came in your room, would they more likely or less likely be able to write with both hands?

Do the same type of activity, but this time use eye color.

c. *Misconceptions/Common Errors*

Many young children believe that an event will happen "because it is my favorite color" or "because it is lucky" or "because it did it that way last time."

d. *Additional Instructional Strategies/Differentiation*

Probability is more than spinning spinners and flipping coins. It helps us answer questions about our world in terms of the chances of future events occurring or not (Teaching Student Centered Mathematics, Van de Walle, page 387, 2004 edition).

In order for students to truly form a foundation of understanding about the language of these terms, the teacher should present a hands-on activity such as "Empty the Bowl" (Math By All Means: Data and Chance, Grades 1-2, Marilyn Burns) to get students fully engaged in understanding the concepts. Spinners, numeral cubes, etc. are essential materials needed in many probability experiments. These materials make the abstract concepts of most likely and most unlikely concrete for children. Once again, the data collected should be organized in the tables, charts, and graphs; and students should be expected to interpret the data and other trends.

e. Technology

Virtual manipulatives should NOT take the place of concrete manipulation of objects/materials. Once conceptual understanding has been reached, you may move to pictorial representations and then virtual manipulatives. Concrete manipulatives should be the focus of learning to build conceptual understanding. Real life situations/representations are critical for conceptual understanding.

- Balloon Bonanza (Students choose between most likely and least likely. If playing whole group, the teacher can adapt words to more likely least likely.) http://www.harcourtschool.com/activity/balloon_bonanza/

- Probability (Students will understand mathematical terms such as more likely and less likely and apply those terms to real life situations. Perform simple experiments to collect data. Determine the probability of different experimental results. Take this one step further and have students represent collected data graphically.) http://www.shodor.org/interactivate/lessons/Probability/

- SMART Notebook Lessons/Activities (This site offers choices of grade levels, subject, and teachers can choose state standard correlations. Browse Educator Resources, Lesson Activities for more than Notebook Lessons. This site also offers SMART Response question sets, teacher-created lessons and activities, SMART sync collaboration activities, and SMART Ideas Software activities. Browse by curriculum standards and the website will find correlated activities for the standard you choose.) http://education.smarttech.com/ste/en-US/Ed+Resource/Lesson+activities/Notebook+Activities/Correlated+Search+us.htm

- SMART Board Interactive Whiteboard Lessons and Resources http://www.scholastic.com/interactivewhiteboards/

f. Assessing the Lesson

Formative assessment is embedded within the lesson through questions and observation. Student responses to the questions posed during the lesson should be used to plan future instruction. However, other formative assessment strategies should be used.

2. Teaching Lesson 4-2 B Infer Trends (Increasing, Decreasing, Random)

2-6.3: Infer trends in a data set as increasing, decreasing, or random. (B2)

For this indicator, it is **essential** for students to
- analyze the data set for trends as increasing, decreasing, or random.
- understand differences in trends in data sets.

For this indicator, it is **not essential** for students to
- interpret data in bar graphs and dot plots.

a. Indicators with Taxonomy

2-6.3: Infer trends in a data set as increasing, decreasing, or random. (B2)
Cognitive Process Dimension: Understand
Knowledge Dimension: Conceptual Knowledge

b. Introductory Lesson

Students collect and record the temperature in degrees Fahrenheit at the same time each school day for two weeks. (This activity works best in the late fall or early spring when the temperature fluctuates more dramatically.) After the second week of data collection, ask the students what facts they can state about the measurements. They may say that all of the numbers are between 50 and 60 degrees or all of the numbers are below 60 degrees. Is there a pattern or trend in the numbers? Are the numbers *increasing* (getting warmer temperatures), *decreasing* (getting cooler temperatures), or are the numbers *random* and not occurring in any particular pattern?

Date and Time	Temperature in Degrees Fahrenheit
October 4 – 10:00 AM	65
October 5 – 10:00 AM	64
October 6 – 10:00 AM	62
October 7 – 10:00 AM	62
October 8 – 10:00 AM	59
October 11 – 10:00 AM	53
October 12 – 10:00 AM	54
October 13 – 10:00 AM	52
October 14 – 10:00 AM	48
October 15 – 10:00 AM	46

c. *Misconceptions/Common Errors*
No typical student misconceptions noted at this time.

d. *Additional Instructional Strategies/Differentiation*
While additional learning opportunities are needed, no suggestions are included at this time.

e. Technology

- Bright Balloons (Students choose between more likely and less likely.) http://www.harcourtschool.com/activity/bright_balloons/

- More, Less, and Equally Likely (Students choose more, less or equally likely from pictures. Discuss equally likely beforehand. Enter site as guest.) http://www.ixl.com/math/practice/grade-2-more-less-equally-likely

f. Assessing the Lesson

Formative assessment is embedded within the lesson through questions and observation. Students should be able to determine trends and the type of trend. Ask students to determine trends at different times of the year for temperature and what they might expect (increasing, decreasing, random). Also, ask students what other questions they might investigate to determine trends.

III. Assessing the Module

At the end of this module summative assessment is necessary to determine student understanding of the connections among and between the indicators addressed in this module. The following examples of possible assessment strategies may be modified as necessary to meet student/teacher needs. These examples are not derived from nor associated with any standardized testing.

2-6. 3 Infer trends in a data set as increasing, decreasing, or random.

The objective of this indicator is to *infer,* which is in the "understand conceptual" knowledge of the Revised Taxonomy table. Conceptual knowledge is not bound by specific examples; therefore, students *infer* trends in a data set as increasing, decreasing, or random. The learning progression to **infer** requires students to *collect* and *represent* data in charts, pictographs, and tables. Students *generate* conjectures and *exchange* mathematical ideas to *infer* trends in data sets as increasing, decreasing, or random.

2-6. 4 Predict on the basis of data whether events are *more likely* or *less likely* to occur.

The objective of this indicator is to *predict*, which is in the "understand conceptual" knowledge of the Revised Taxonomy table. Conceptual knowledge is not bound by specific examples; therefore, students *predict* on the basis of the data whether events are more likely or less likely to occur. The learning progression to **predict** requires students to *collect* and *represent* data using a variety of forms of mathematical communication (2-1.6). Students *generate* conjectures and *exchange* mathematical ideas to *predict* whether events are more likely or less likely to occur.

1. Mrs. Smith's class recorded the temperature at 11:00 a.m. each day for two weeks. The chart shows their data.

Date and Time	**Temperature in Degrees Fahrenheit**
March 4, 11:00 a.m.	57
March 5	59
March 6	59
March 7	58
March 8	60
March 11	61
March 12	61
March 13	63
March 14	63
March 15	65

Would you describe the temperature trend as increasing, decreasing, or random? Explain your reason.

Assessment item #2 adapted from *Grade 3-5 Mathematics Assessment Sampler***,** Jane D. Gawronski, editor. National Council of Teachers of Mathematics, 2005. Pages 186-187

2. The 16 stickers listed below are placed in a box. If one sticker is drawn from the box, which color are you more likely to pick?

Sticker Color	**Number**
Red	3
Blue	4
Yellow	2
Green	7

3. Stacia stood in front of the classroom hundreds chart. She closed her eyes and put her finger on the chart.

A. Is it less likely that she put her finger on a one-digit number or a two-digit number? Explain your answer.

B. Is it more likely that she put her finger on a number that is greater than 44 or less than 44? Explain.

MODULE

4–3

Qualitative and Quantitative Change

This module addresses the following indicators:

2-3.4: Identify quantitative and qualitative change over time. (B1)
2-3.5: Analyze quantitative and qualitative change over time. (B4)

This Module contains 1 introductory lesson. These lessons are **INTRODUCTORY ONLY**. Lessons in S3 begin to build the conceptual foundation students need. **ADDITIONAL LESSONS will be required** to fully develop the concepts.

I. Planning the Module

The first bullet under the Continuum of Knowledge represents students prior knowledge and/or skills related to this standard. It is recommended that students are pre-assessed on this prior knowledge.

- **Continuum of Knowledge**

  2-3.4: Identify quantitative and qualitative change over time. (B1)
  - In first grade, students classify change over time as quantitative or qualitative. (1-3.3)
  - In second grade, students identify quantitative and qualitative change over time. (2-3.4)
  - In third grade, students illustrate situations that show change over time as increasing. (3-3.4)

  2-3.5: Analyze quantitative and qualitative change over time. (B4)
  - In first grade, students classify change over time as quantitative or qualitative. (1-3.6)
  - In second grade, students analyze quantitative and qualitative change over time. (2-3.5)
  - In third rade, students illustrate situations that show change over time as increasing. (3-3.4)

- **Key Concepts/Key Terms**

  *These are vocabulary terms that are reasonable for students to know and be able to use. Terms without the * are additional terms for teacher awareness, knowledge and use in conversation with students.

  *Quantitative
  *Qualitative
  *Analyze

II. Teaching the Lesson(s)

1. Teaching Lesson 4-3A Identify and Analyze Change Over Time

2-3.4: Identify quantitative and qualitative change over time.

For this indicator, it is **essential** for students to:
- Compare examples of quantitative and qualitative change.
- Understand the difference between quantitative and qualitative change.
- Use the terms qualitative and quantitative

For this indicator, it is **not essential** for students to:
- Illustrate situations that show change over time as increasing.

2-3.5: Analyze quantitative and qualitative change over time.
For this indicator, it is **essential** for students to:
- understand the difference between quantitative and qualitative change over time.

For this indicator, it is **not essential** for students to:
- illustrate situations that show change over time as increasing.

a. Indicators with Taxonomy

2-3.4: Identify quantitative and qualitative change over time. (B1)
Cognitive Process Dimension: Remember
Knowledge Dimension: Conceptual Knowledge

2-3.5: Analyze quantitative and qualitative change over time. (B4)
Cognitive Process Dimension: Analyze
Knowledge Dimension: Conceptual Knowledge

b. Introductory Lesson

Suggested Literature Connection
Step by Step by Bruce McMillan
Pictures show a little boy as he grows from crawler to walker and spans 4 months to fourteen months – thus quantitative and qualitative illustrations.

Materials:
Celsius and Fahrenheit thermometers

Lesson:
Teacher Note:
This may be an opportunity to make connections between math and science.

Place one of each kind of thermometers in easy to read locations- inside the classroom, outside in the sun, and outside in the shade. Have the students read and record the temperature at the same time everyday once in the morning and once in the afternoon. After a week of recording the temperature, have them work in groups to represent their data. Then ask: What are you noticing about the data? What might be some reasons for the temperature changes? Pick out two different readings and ask: How much time elapsed from the first reading to the second reading? Did the temperature increase or decrease? Explain that this is a qualitative change because it is descriptive and not numerical. Then ask: How much did it change? Explain that this is a quantitative change because it is a numerical change.
Have them work in groups to write some qualitative and quantitative facts about their data. Then ask them to predict what the temperature will be in a week. Ask: Why data are you basing your prediction on?

c. *Misconceptions/Common Errors*
No typical student misconceptions noted at this time.

d. *Additional Instructional Strategies/Differentiation*
Students will identify quantitative (number) and qualitative (attribute) changes. An example of quantitative change would be growing 4 inches, while growing taller would be the qualitative change.
An example of a qualitative question students should be able to answer is, "Taylor is taller this year than last year. Identify the type of change over time." As students analyze this qualitative change over time, students should be able to say that the time is one year and the change is Taylor growing taller.

An example of a quantitative question students should be able to answer is, "Taylor is 3 inches taller this year than last year. Identify the type of change over time." As students analyze this quantitative change over time, students should be able to say that the time is one year and the change is three inches taller. Other examples that could be used would be popsicles melting or being eaten, pencils used during the day, or Twizzlers being eaten.

An example of a qualitative question students should be able to answer is, "Taylor is taller this year than last year. Identify the type of change over time." As students analyze this qualitative change over time, students should be able to say that the time is one year and the change is Taylor growing taller.

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the type of change over time." As students analyze this quantitative change over time, students should be able to say that the time is one year and the change is three inches taller.
Other examples that could be used would be popscicles melting or being eaten, pencils used during the day, or Twizzlers being eaten.

e. Technology

Virtual manipulatives should NOT take the place of concrete manipulation of objects/materials. Once conceptual understanding has been reached, you may move to pictorial representations and then virtual manipulatives. Concrete manipulatives should be the focus of learning to build conceptual understanding. Real life situations/representations are critical for conceptual understanding.

- Plant Color (This lesson integrates math and science. Students sort, classify, and discuss how plant color changes over time and why.) http://primary-school-lesson-plans.suite101.com/article.cfm/plant_color_elementary_math_science_lesson_plan

- As People Get Older, They Get Taller (In this two-lesson unit, students compare the heights of friends and classmates at different ages. Through the course of the lessons, students are exposed to algebra, measurement, and data analysis concepts. A major theme of the unit is analyzing change.) http://illuminations.nctm.org/LessonDetail.aspx?id=U171

- Use computers to graph data collected from the classroom, such as plant growth. Have students compare data monthly and discuss change over time.

- SMART Notebook Lessons/Activities (This site offers choices of grade levels, subject, and teachers can choose state standard correlations. Browse Educator Resources, Lesson Activities for more than Notebook Lessons. This site also offers SMART Response question sets, teacher-created lessons and activities, SMART sync collaboration activities, and SMART Ideas Software activities. Browse by curriculum standards and the website will find correlated activities for the standard you choose.) http://education.smarttech.com/ste/en-US/Ed+Resource/Lesson+activities/Notebook+Activities/Correlated+Search+us.htm

- SMART Board Interactive Whiteboard Lessons and Resources http://www.scholastic.com/interactivewhiteboards/

f. Assessing the Lesson

Formative assessment is embedded within the lesson through questions and observation. Student responses to the questions in the lessons should demonstrate a clear understanding of the difference between qualitative and quantitative data. Future instructional experiences should be developed based on their understanding of these concepts. However, other formative assessment strategies should be used.

III. Assessing the Module

At the end of this module summative assessment is necessary to determine student understanding of the connections among and between the indicators addressed in this module. The following examples of possible assessment strategies may be modified as necessary to meet student/teacher needs. These examples are not derived from nor associated with any standardized testing.

2-3.4 Identify quantitative and qualitative change over time.

The objective of this indicator is to identify, which is in the "understand conceptual" cell of the Revised Taxonomy table. Conceptual knowledge is not bound by specific examples: therefore students should compare quantitative and qualitative change over time. The learning progression to **identify** requires students to analyze situations and determine if change has occurred. They generate conjectures and exchange mathematical ideas (2-1.2) about their observations. They use that information to identify the change as quantitative and qualitative. Students also give examples of situations that show a change in quality and a change in quantity.

2-3.5 Analyze quantitative and qualitative change over time.

The objective of this indicator is to analyze, which is in the "analyze conceptual" knowledge of the Revised Taxonomy table. To analyze is to break down material (change) into it parts (quality or quantity) and determine how the parts relate to one another and the overall structure. The learning progression to **analyze** requires students to explore a variety of situations and generate conjectures about the changes their observations (2-1.2). They determine if change has occurred and if so, decide if it is a change in quality or quantity. Students exchange these mathematical ideas (2-1.2) with their classmates and teacher using a variety of forms of communication (2-1.6).

1. Use the chart to answer the questions.

	Monday	Tuesday	Wednesday	Thursday	Friday
Temperature	45°F	43°F	41°F	42°F	39°F

a. How did the temperature change?

b. How much time passed?

2. Matt's mother measured his height on his birthday, beginning with his third birthday. She recorded the data in a chart.

Age	Height
3 years old	37 inches
4 years old	41 inches
5 years old	47 inches
6 years old	51 inches

a. How much time has passed since Matt's mother started measuring his height?
b. Write two statements that describe the change in Matt's height.

MODULE

4–4

Multiplication and Division

This module addresses the following indicators:

2-2.5: Interpret models of equal grouping (multiplication) as repeated addition and arrays. (B2)
2-2.6: Interpret models of sharing equally (division) in as repeated subtraction and arrays. (B2)

This module contains 2 lessons. These lessons are **INTRODUCTORY ONLY**. Lessons in S3 begin to build the conceptual foundation students need. **ADDITIONAL LESSONS will be required** to fully develop the concepts.

I. Planning the Module

The first bullet under the Continuum of Knowledge represents students prior knowledge and/or skills related to this standard. It is recommended that students are pre-assessed on this prior knowledge.

Continuum of Knowledge

2-2.5: Interpret models of equal grouping (multiplication) as repeated addition and arrays. (B2)

- In second grade, students interpret models of equal grouping as repeated addition and arrays. (2-2.5)
- In third grade, students recall basic multiplication facts through 12 × 12 and the corresponding division facts. (3-2.7)

2-2.6: Interpret models of sharing equally (division) in as repeated subtraction and arrays. (B2)

- In second grade, students interpret models of sharing equally as repeated subtraction and arrays. (2-2.6)
- In third grade, students recall basic multiplication facts through 12 × 12 and the corresponding division facts. (3-2.7)

Key Concepts/Key Vocabulary

*These are vocabulary terms that are reasonable for students to know and be able to use. Terms without the * are additional terms for teacher awareness, knowledge and use in conversation with students.

*Repeated subtraction
*Arrays
*Equal sharing/sets
*Vertical columns
*Horizontal rows
*Repeated addition
*Addends
*Equal grouping/sets

II. Teaching the Lesson(s)

1. Teaching Lesson 4-4A Multiplication as Repeated Addition and Arrays

2-2.5: Interpret models of equal grouping (multiplication) as repeated addition and arrays. (B2)

For this indicator, it is **essential** for students to:

- Use concrete objects in arrays and then pictures of arrays and equal groupings that show repeated addition.
- Act out number stories that illustrate multiplication as repeated addition and represent the same story by creating arrays.

For this indicator, it is **not essential** for students to:

- Be introduced to actual multiplication.
- Memorize multiplication facts.

a. Indicators with Taxonomy

2-2.5: Interpret models of equal grouping (multiplication) as repeated addition and arrays. (B2)

Cognitive Process Dimension: Understand
Knowledge Dimension: Conceptual Knowledge

b. Introductory Lesson

Teacher Notes: Just as opportunities were given for students to investigate addition and subtraction in the first grade, opportunities must be given for them to investigate multiplication and division in the second grade. This does not mean second grade students should be introduced to actual multiplication or division. Rather they are simply using their knowledge of repeated addition and sharing equally to put objects in arrays or to interpret arrays. (The term "interpret" includes the verbs *translate, represent, clarify, and paraphrase.)* Understanding the concept of repeated addition and sharing equally as arrays should be accomplished by using concrete materials and then pictures of arrays and equal groupings that show repeated addition (4 rows of three, or 4 groups of three) and repeated subtraction (sharing equally) (4 children equally sharing 12 pieces of candy). Teachers and students should use the terms *vertical* (columns) and *horizontal* (rows) in describing the array, and use the phrase *equal* groupings to mean sets of objects. Students should act out number stories that illustrate multiplication as repeated addition and represent the same stories by creating arrays with concrete materials. For example a problem that could be posed to students is: "There are five students in Ms. Davis'

class. Each of the students has 3 new pencils. How many pencils do the five students have?" This problem would NOT be introduced as 5 x 3 but would be drawn as a 5 by 3 array or by equal groupings of pencils or pictures of pencils lined up in a 5 by 3 array.

The concept of division as repeated subtraction begins with a whole set of objects that must be shared equally (no remainders for this experience). For example, in the story "And the Doorbell Rang" 12 cookies are to be shared by friends. If there were two friends the cookies could be shared as a 2 by 6 array. If there were 3 friends, then a 3 by 4 array would result. The concept of "subtraction" comes in as student remove cookies from the original pile to form the array. Again, the concept of division is NOT introduced, but students have informally investigated the concept as sharing equally and arrays. The emphasis in second grade is on building the conceptual knowledge and understanding so that in later grades they can link repeated addition to multiplication and repeated subtraction to division. In third grade, students will be formally introduced to the concept of multiplication and in fourth grade the concept of division will be formally introduced.

Lesson: This concept should be introduced with word problems and manipulatives to act out the word problem. There are two types of multiplication problems: equal groups and multiplicative comparison problems. In second grade, equal groups are introduced with concrete materials. As the students understand the conceptual knowledge of equal groups, then they can be represented in arrays, both with manipulatives and then pictorial.

Example:
Four friends worked together to clean up the playground after field day. They each picked up 5 cups. How many cups did they pick up all together?

Have the students work in groups to illustrate the answer to the problem. Using paper cups, the students decide how they want to represent the answer. Ask "How do you know the answer is correct? Why did you decide to represent it this way?" If a group has made a 4 X 5 array, say "This is the way this type of problem is usually represented by mathematicians. Each row represents one of the friends and the five cups in the row represents the cups that each friend picked up." It makes it easy to count the cups by skip counting. Talking about the problem and discussing how and why they solved it the way they did is the most important part of this lesson. Two or three problems like this are all you should need for one class period.

More examples:

- Jerry has 4 bags of candy. There are 6 pieces of candy in each bag. How many pieces of candy does Jerry have?
- If candy cost 10 cents each, how much did Jerry have to pay for 5 pieces of candy?
- Jerry ate 7 pieces of candy every hour for 3 hours. How many pieces of candy did Jerry eat?

c. *Misconceptions/Common Errors*

No typical student misconceptions noted at this time.

d. *Additional Instructional Strategies/Differentiation*

Teachers should provide multiple experiences with real life examples to make the connection that repeated equal groupings can also be represented with arrays. Teachers should use the terms vertical columns and horizontal rows when describing the arrays.
Student could use their shoes to show that 1 person with 2 shoes has 2 shoes and the resulting array of 1 by 2. Two students with 2 shoes each would have 2 + 2 = 4 shoes, or two groups of two, resulting in a 2 by 2 array, etc. The same could be done with 3, 4, 5, groups as well.

e. Technology

Virtual manipulatives should NOT take the place of concrete manipulation of objects/materials. Once conceptual understanding has been reached, you may move to pictorial representations and then virtual manipulatives. Concrete manipulatives should be the focus of learning to build conceptual understanding. Real life situations/representations are critical for conceptual understanding.

- Lemonade Larry (Students are shown the price of lemonade and given how many cups the child wishes to buy. They have to determine the total cost. Have students show how they are determining their answers. They can also make arrays using lemons or pictures of lemons.) http://www.prongo.com/lemon/game.html
- Number Line Jumper (Use this tool to show repeated addition on a number line.) http://www.ictgames.com/numberlineJumpMaker/index.html
- SMART Board Lesson on Repeated Addition: http://pdtogo.com/smart/?p=149
- SMART Notebook Lessons/Activities (This site offers choices of grade levels, subject, and teachers can choose state standard correlations. Browse Educator Resources, Lesson Activities for more than Notebook Lessons. This site also offers SMART Response

question sets, teacher-created lessons and activities, SMART sync collaboration activities, and SMART Ideas Software activities. Browse by curriculum standards and the website will find correlated activities for the standard you choose.) http://education.smarttech.com/ste/en-US/Ed+Resource/Lesson+activities/Notebook+Activities/Correlated+Search+us.htm

- SMART Board Interactive Whiteboard Lessons and Resources http://www.scholastic.com/interactivewhiteboards/

f. Assessing the Lesson

Formative assessment is embedded within the lesson through questions and observation. Student responses to the word problems in the lesson will determine future learning experiences. Encourage students to generate multiple strategies to solve the word problems. Students may also work with a partner and explain how they solved the problems. However, other formative assessment strategies should be used.

2. Teaching Lesson 4-4B Division as Repeated Subtraction and Arrays

2-2.6: Interpret models of sharing equally (division) in as repeated subtraction and arrays. (B2)

For this indicator, it is **essential** for students to:

- Use concrete objects in arrays and then pictures of arrays and sharing equally that show repeated subtraction.
- Act out number stories that illustrate division as repeated subtraction and represent the same story by creating arrays.

For this indicator, it is **not essential** for students to:

- Memorize division facts.
- Be exposed to remainders.
- Be introduced to actual division.

a. Indicators with Taxonomy

2-2.6: Interpret models of sharing equally (division) in as repeated subtraction and arrays. (B2)

Cognitive Process Dimension: Understand
Knowledge Dimension: Conceptual Knowledge

b. Introductory Lesson

As with the repeated addition lesson, repeated subtraction (division) should be introduced with a word problem and manipulatives to act out the problem.

Examples:

- John has 24 crayons. He wants to share them equally with his 4 friends. How many crayons will each friend receive?
- John paid 35 cents for 5 crayons. How much did he pay for each one?
- John walked 9 miles in 3 hours. How many miles per hour did he walk?

Students should work in groups with manipulatives to answer these problems. The more the problems relate to the lives of the students, the better they will understand the concepts. Ask: How might you solve this problem? If you solve it that way, what will you find out? How do you know? How will you know if you are correct?

Have the students compare answers. If the answers are different, have each one explain why they think their answer is correct. Let them explore each groups theory and determine which one is correct.

c. *Misconceptions/Common Errors*

No typical student misconceptions noted at this time.

d. *Additional Instructional Strategies/Differentiation*

Teachers should provide multiple experiences with real life examples to make the connection that sharing equally can also be represented with arrays. Teachers should use the terms vertical columns and horizontal rows when describing the arrays.
In *The Doorbell Rang* twelve cookies are shared by friends. If there were two friends the cookies would be shared as a 2 by 6 array. If three friends shared then a 3 by 4 array would result.

e. Technology

Virtual manipulatives should NOT take the place of concrete manipulation of objects/materials. Once conceptual understanding has been reached, you may move to pictorial representations and then virtual manipulatives. Concrete manipulatives should be the focus of learning to build conceptual understanding. Real life situations/representations are critical for conceptual understanding.

- Repeated Subtraction Problem Solving (Use this file the same as the introductory lesson.) http://www.eduplace.com/math/hmcam/problem/pdf/2/2hmmca-cr-22-03-ps.pdf

- SMART Notebook Lessons/Activities (This site offers choices of grade levels, subject, and teachers can choose state standard correlations. Browse Educator Resources, Lesson Activities for more than Notebook Lessons. This site also offers SMART Response question sets, teacher-created lessons and activities, SMART sync collaboration activities, and SMART Ideas Software activities. Browse by curriculum standards and the website will find correlated activities for the standard you choose.) http://education.smarttech.com/ste/en-US/Ed+Resource/Lesson+activities/Notebook+Activities/Correlated+Search+us.htm

  SMART Board Interactive Whiteboard Lessons and Resources http://www.scholastic.com/interactivewhiteboards/

f. Assessing the Lesson

Formative assessment is embedded within the lesson through questions and observation. Student responses to the word problems should determine future learning experiences. Students should be able to explain how they solved the problem and be share with their partners. Teacher observations and questioning of these processes will determine student understanding. However, other formative assessment strategies should be used.

III. Assessing the Module

At the end of this module summative assessment is necessary to determine student understanding of the connections among and between the indicators addressed in this module. The following examples of possible assessment strategies may be modified as necessary to meet student/teacher needs. These examples are not derived from nor associated with any standardized testing.

2-2.5 Interpret models of equal grouping (multiplication) as repeated addition and arrays.

The objective of this indicator is to interpret, which is in the "understand conceptual" cell of the Revised Taxonomy table. Conceptual knowledge is not bound by specific examples; therefore students should translate, represent,

clarify, and paraphrase models of equal grouping. The learning progression to **represent** requires students to *recognize* that repeated addition is adding the same number and that arrays are pictorial representations of repeated addition. Students then *construct* arrays to represent repeated addition. Given array models, students *analyze* for patterns of repeated addition and *generalize* mathematical concepts of equal grouping as repeated addition and arrays. (2-1.4, 2-1.5)

2-2.6 Interpret models of sharing equally (division) as repeated subtraction and arrays.

The objective of this indicator is to interpret, which is in the "understand conceptual" cell of the Revised Taxonomy table. Conceptual knowledge is not bound by specific examples; therefore students should translate, represent, clarify, and paraphrase models of equal grouping. The learning progression to **represent** requires students to *recognize* that repeated subtraction is subtracting the same number and that arrays are pictorial representations of repeated subtraction. Students then *construct* arrays to represent repeated subtraction. Given array models, students *analyze* for patterns of repeated subtraction and generalize mathematical concepts of sharing equally as repeated subtraction and arrays. (2-1.4, 2-1.5)

Teacher note: Summative assessment items for this module should be story problems so students can use a variety of strategies to solve the problems.

These assessment items #1 and #2 are from Prekindergarten – Grade 2 Mathematics Assessment Sampler, DeAnn Huinker, editor. National Council of Teachers of Mathematics. 2006. pages 42-46.

1. Robin has 3 packages of gum. Each package has 5 pieces of gum.

a. How many pieces of gum does Robin have altogether?

b. Draw a picture to show how much gum Robin has. Find the answer, and write a number sentence to solve the problem.

2. 24 people are going to watch a movie. The movie theater has 24 chairs. Each row has the same number of chairs.

a. How many rows does the theater have?

b. Draw a picture of two solutions to this problem.