Necessary Nano

Exploring concepts of measurement, ratio, and volume in the elementary classroom.

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This curriculum unit is recommended for:
2nd Grade Math

Keywords: nanoscience, measurement, volume

Teaching Standards: See Appendix 1 for teaching standards addressed in this unit.

Synopsis: *Necessary Nano* is a unit plan created with the hopes of providing 2nd graders with a more in depth understanding surrounding the concepts of measurement. It will allow for students to explore measurement tools in a way that will allow them to determine the appropriate tool to measure selected objects. In addition to exploring measurement tools, students will also learn different units of measurement.

I plan to teach this unit during the coming year to 16 students in 2nd Grade.

Necessary Nano: Exploring concepts of measurement, ratio, and volume in the elementary classroom

Kimberly Scouller

Introduction

"Necessary Nano" is a unit plan created for a 2nd grade classroom. The purpose of this unit plan is to give students at the elementary level a more in depth understanding surrounding the concepts of measurement. This unit has been created as the end result of my participation as a Charlotte Teaching Institute fellow in the seminar entitled "It's a Small World," led by Dr. Marcus Jones. During our time in seminar we studied concepts surrounding nanoscience. It soon became evident the important role of nanoscience in our world today, as well as the implications on our future. Over the course of our study, the topics of measurement and scale were reoccurring themes that stuck with me as being critical in understanding the world of nanoscience. As an educator of young children, I take it as my personal responsibility to inspire, excite, and set the foundation for in our young children to further explore nanoscience, beginning with the topic of measurement and scale.

I have found in previous teaching experiences that children of this age, and often older children, are taught how to use basic measurement tools and are able to measure objects in customary units, but do not necessarily understand the differences in units of measurement. Similarly, they often do not understand the differences in units of measurement, for example not understanding the difference between a centimeter or an inch. I feel it is necessary to create this curriculum unit to give students a complete and in-depth understanding of all units of measurement. Having strong background knowledge on measurement concepts is absolutely necessary because it will continuously be encountered in real life circumstances.[1]

Rationale

According to Martinie, "instruction involving measurement involving measurement should focus on teaching students K-12 to understand measurable attributes of objects….and apply appropriate techniques, tools, and formulas to determine measurements."[2] Throughout this unit, students will be exposed to content that covers both 2nd grade common core standards for mathematics, as well as the North Carolina essential standards for science. In the 2nd grade students are expected to know both customary and metric units. For example, they are to be able to measure an object in both inches and feet, as well as centimeters and meters, and when given a particular object to measure, students at this level are expected to pick an appropriate tool to measure the object in the correct unit of measurement. Students are also to be exposed to

the concept of iteration, understanding that the same objects of the same size (i.e. unifex cubes or paper clips) can be used over and over again to measure the length of an object. The idea of spatial relationships is a critical concept in 2nd grade mathematics. Students must understand the relationship between how large the object is that they are measuring and how many units they will need in order to determine the length of that object; the smaller of measure is, it will take more units to measure the selected object. Students will be exposed to this concept through the use of measuring objects with varying units of measure. For example, students will be asked to measure the length of the classroom using varying objects. The conclusion of this activity being that the smaller the object in which we are using to measure, it will require more to complete the measurement of the classroom. The unit they chose to measure with is just as important as the object that they are measuring.[3]

Teaching these measurement skills at this age is of great importance because of the connections to future mathematical skills, as well as scientific concepts. In the area of mathematics, understanding and having a foundation of the metric system lends itself to a deeper comprehensive understanding of place value. Similarly, understanding and working with customary units of measurement allows for deeper exploration of fractions.[4] Additionally, "applying estimation strategies and techniques, applying the concepts of similarity and scaling, collecting and analyzing data, and generalizing measurement techniques to produce formulas connect measurement to the Geometry, Data Analysis and Probability, and Algebra Standards."[5]

Background: ***Demographics***

Teacher

I attended The College of St. Rose in Albany, NY receiving my Bachelor of Science degree in Early Childhood Education in 2008. I also attended The College of St. Rose for graduate studies, receiving my Masters of Science in Elementary Education in 2011. I am currently certified as an elementary teacher, grades K-6 in North Carolina. I have been teaching for 5 years. I began my teaching career as a Universal Pre-Kindergarten teacher in the Albany City School District in Albany, NY for the head start program, which serves low-income families. Upon moving to North Carolina in 2012, I continued teaching Pre-K for head start. I then taught for two years in charter schools in Charlotte, North Carolina, then moving to teach for the Charlotte-Mecklenburg Schools as a 2nd grade teacher for Barringer Academic Center.

School

Barringer Academic Center (BAC) is one of Charlotte-Mecklenburg's 178 elementary schools, serving grades kindergarten through grade 5 located in the west learning community of Charlotte, North Carolina. BAC opened in 1952 as a full magnet school, meaning that students in grades K-2 were enrolled in the Learning Immersion program.

Students in grades 3-5 were Talent Development certified. In 1999 BAC added a Horizons program for highly gifted students. In 2002 BAC became a partial magnet school by adding home school students that were living in the surrounding area.

Currently, BAC has 593 students enrolled in grades K-5. 56% of the students are African American, 21% Asian, 16% White, 4% Hispanic, .1% Multi-Racial, .3% American Indian, and .1% Native Hawaiian or Pacific Islander. The home school are of BAC is an "economically disadvantaged community comprised primarily of African-American students."[6] The students in the magnet portion of BAC feed into three different high schools: Providence, Myers Park, and South Mecklenburg High School. These schools generally consist of upper to middle class households.

BAC currently has 30 classroom teachers, 4 Horizon teachers, and 5 Instructional Assistants to help with small group instruction.[7]

Students

I teach 2nd grade in the home school portion of BAC. My class contains 16 2nd graders, 8 girls and 8 boys. 100% of the students in my classroom are African-American. All students receive free or reduced lunch. There are two students who are identified as learning disabled with Individualized Education Plans (IEP's). One student receives pull-out special education services. The other student receives occupational therapy, speech therapy, and pull special education services. "Necessary Nano" will take place during math instruction including both whole-group, small-group, and hands-on inquiry based lessons. This unit will take place over a 2 week (10 day) period. The instructional and inquiry time will vary depending on prior knowledge of the children, or the lesson being taught.

Objectives

By the end of implementation of this curriculum unit, my students will be able to meet the following objectives:

- Name various tools for measurement (ruler, yard stick, meter stick, tape measure.
- Identify and be able to compare different units of measurement (centimeters, inches, meters, yards, and feet).
- Identify the difference and be able to measure the length, width, and height (find the volume) of various objects.
- Compare the size of different units of measurement
- Have an understanding of volume by recognizing that different sizes of the same objects will fill the volume of a container differently.

- Understand that objects can be divided into sections, creating a smaller measurement scale
- Understand the concept of scales in a way which represents that objects can be big and so small that we cannot see them.

Content Research

Although content standards indicate that students must be understanding measurable attributes of objects and choose appropriate tools to measure those objects, research indicates that students are not having opportunities to practice with measurement tools.[8] According to Martinie, students are being "instructed in measurement skills in school, they cannot show that they have learned the concept."[9] Additionally, students are being "deprived of the opportunity to consider what attribute to measure, to select and appropriate unit of measure, to decide on the appropriate measurement tool, and to understand formulas and how the work. The scenarios create a gap between school math and real-word math."[10] There is a misconception among some educators that as students grow older their knowledge of geometry and measurement will grow as well, however it is essential that children have exposure to and experience to engage in various activities that allows them to explore concepts and ideas pertaining to measurement.[11]

Teaching measurement in a meaningful hands-on approach is critical because it helps build foundation for future mathematical skills. However, it is also necessary for application in scientific practice. Measurement is an essential function of being to perform and test scientific theories.[12]

> Numbers point out disagreements about a theory, an authority, or a delicate subject that no qualitative technique can reach, and this gap is enough to trigger research. Measurements made in a controlled experiment framework therefore supply the proof needed to answer questions that no theoretical debate can do on its own…Activities that call upon measurements and instruments can also serve to test a hypothesis, establish a law, fund the values of parameters or physical constraints, compare a theory to experience, verify a theory, determine the field of validity of a theory or model, or fit a model.[13]

Thus far in education, measurement has been taught as a "know-how", without any scientific or data processing implications attached to it. According to Brehelin, Munier and Merle, "numerous studies" have been conducted in the 1990's that document the struggles and challenges that students have faced in processing measurement data, and

"showed that students have trouble going from a deterministic view of science to a probabilistic view."[14] The probabilistic view is required in order to understand the "dispersion of measures and is emphasized by the official teaching instructions…the idea students have of measurement is associated with the idea of searching for the 'right' value to be compared to a standard value known by the teacher." This idea is reiterated by Martinie, when discussing the way in which students are exposed to measurement.

> …when students are given a page with pictures of objects and each object has a picture of a ruler aligned properly under it, students simply practice reading the ruler to measure the object. This scenario is not how measurement is performed in the real word and results in the inability not only to perform measurement procedures but also to understand what the concept of measurement really means.[15]

Processes & Skills Addressed

Throughout this unit plan, the following processes and skills will be addressed:

- Identifying various measurement tools:
  - Ruler
  - Yardstick
  - Meter stick
  - Scale
  - Tape measure
  - Graduated cylinders
- Measuring quantities: using numbers to describe objects by:
  - Counting parts
  - Measuring different parts with various measurement tools
  - Comparing objects based on size
- Sorting and classifying objects based on size
- Selecting an appropriate measurement tool
- Estimating the length of an object
- Identifying different units of measurement:
  - Inches
  - Meters
  - Centimeters
  - Millimeters
  - Nanometers

Teaching Strategies

A variety of instructional strategies will be used throughout the implementation of the curriculum unit. The main instructional strategy that will be utilized is the direct instruction model. Direct instruction is one of the more common instruction models used. It allows for the teacher to deliver vital information to students straightforwardly. The information that is presented during a direct instruction lesson should be information directly related to the lesson objective in order for the students to achieve mastery.[16]

An additional instructional strategy that will be utilized is inductive teaching. In the inductive teaching model students will be able to "create or discover important ideas by interacting with concrete materials or other data sources and their peers," In the inductive teaching model, the teacher guides students to interact with concrete materials in order for the students to not only draw their only conclusions, but to formulate hypothesis.[17]

The final instructional strategy that will be utilized during this curriculum unit is cooperative learning. The cooperative learning model is considered effective because it encourages content learning, social interaction and positive student attitude toward learning the particular subject matter. Students are expected to work together and help each other learn in small groups. Cooperative learning is not simply working in groups, but also needs to incorporate *positive interdependence*, where students depend on each other for success. *Individual accountability,* where each student must be accountable for mastery of the objectives. *Equal participation* ensures that all students contribute equally to the group.[18]

Classroom Activities

Day 1

Purpose: In this lesson students will be exposed to various measurement tools. At this point, students will have basic knowledge of a ruler. This lesson will allow them to be introduced to a ruler.

Objectives: Students will be able to accurately use a ruler by placing the object at the 0 mark. Students will be able to use a ruler to correctly measure an object in centimeters or inches. Students will be able to understand the differences in a unit of measure between a centimeter and an inch.

Procedure: At the beginning of this lesson, the teacher will ask students to help solve a problem. The teacher will explain that this morning they tried to measure a pencil with a ruler in order to determine how long it was, but kept getting different answers. Teacher will ask the students to help figure out why the answers were so different.

The teacher can demonstrate how they were arriving at different answers by taking a pencil and a ruler and showing the students incorrect ways that the pencil was measured. For example:

- Placing the pencil at the 1 inch (or any varying number) mark instead of the 0
- measuring in inches
- measuring in centimeters
- measuring the width

The teacher will ask the students to help come up with the right measurement. At this point, the teacher may have to guide the students to show how to properly measure the pencil. After pausing for a guided class discussion, allowing students the opportunity to share their thoughts, the teacher will then demonstrate how to properly measure a pencil in inches and in centimeters. After measuring in both inches and in centimeters, write the measurements on a whiteboard, smartboard, or anywhere visible to the class. Ask: How come we measured the pencil with the same tool, a ruler, and we have two different numbers? Allow the students to turn to a partner (turn pair share), and give them some time to share their thoughts with each other. Facilitate a guided class discussion with the end result being that there were two different numbers because a ruler has two different unit of measurement; centimeters and inches. Centimeters are a smaller unit of measurement, so the number will be bigger. If time persists, give each student a ruler and allow them to measure classroom objects in both centimeters and objects (desks, pencils, chairs, etc.)

Day 2

Purpose: In this lesson students will have the opportunity to practice using and measuring with various measurement tools. This lesson will take place during a math workshop, a time in which there are various math centers set up around the classroom that the students will work together in collaboratively and rotate throughout each station.

Objective: Students will be able to measure objects accurately in inches, centimeters, yards, and feet when given the object and the measurement tool.

Procedure: The teacher will begin the lesson whole group by showing the class the ruler from the Day 1 lesson, asking the class if they remember what it is called. Explain that there are other tools that we use to measure besides a ruler. Sometimes we have to measure objects that are larger than our pencils, for that we would have to use a bigger measuring tool. Introduce at this time the yardstick. Show that 3 rulers make up a yardstick. Ask the class which kind of objects could we measure with a yardstick? Where have you heard the term yard before? Show a tape measure. What could we measure with a tape measure? Where have you seen a tape measure before? Then, allow the students to practice using the measurement tools in their workshop stations.

To set up the workshop stations before the math workshop time, the teacher will set up 5 stations and number them accordingly. Set out the measurement tool at each station as well as the object that you wish the students to measure. (The object is not of great importance, just that the students are measuring with the tool correctly). The four measurement tools to use: ruler (inches), ruler (centimeters), tape measure (feet), and a yardstick. The students will measure the object at each station and record it on the provided data record sheet. (See Appendix 2)

Day 3

Purpose: The purpose of this lesson is to allow students the opportunity to measure using non-customary units of measurement. Students will work collaboratively in groups for this activity. Each group will be given one of the following units of measurement: unifex cubes, unsharpened pencils, and long wooden dowels. Each group will be asked to measure a specific portion of the hallway.

Objective: Students will be able to use non-customary units of measurement to accurately measure a portion of the hallway. Students will be able to determine that the smaller unit of measure, the more units it will take to measure an object.

Procedure: Begin the lesson by telling the students that we have been using measuring tools for the past couple of days to measure specific objects, but sometimes, you may have to measure something, and you might not have a ruler or a tape measure with you. Show students each object and explain what it is: a unifex cube (students will be familiar with these from use in math class with patterns and ten frames), unsharpened pencils with erasers, and long wooden dowels from the art supply store. Explain to the students that they are each going to break up into groups and measure a part of the hallway with the objects.

After explaining to the students that they will be using their objects to measure the hallway. Have the students turn to each other and discuss which object they think will take the most to measure the length of the hallway? Which object will take the least? After the students have had a chance to share with each other, have them go out and measure the hallway. Once back in the classroom, ask each group how many objects it took. Lead a class discussion regarding the size of the units of measurement. The end result of this lesson being that students will understand that the smaller the unit of measure, the more it will take to measure the length of an object.

Day 4

Purpose: The purpose of this lesson is to give students the understanding that objects can be really big and objects can also be very small, so small that we sometimes cannot see

them! Also, to allow students the opportunity to explore range of size and ratio in measurement.

Objectives: When given cards with measurements students will be able to accurately order meter, centimeter, millimeter, and nanometer in size order from largest to smallest.

Procedure: Show students a meter stick. Then, show them an object that is a centimeter long. Explain that one hundred centimeters make up a meter. Ask leading questions: "Is a centimeter bigger or smaller than a meter?" Explain a millimeter, and that it takes one thousand millimeters to make up a meter! Ask the students if they have ever seen a thousand of anything? Or something that is one millimeter long? Tell them to look at the thickness of their fingernail (NOT how long it is), and that is ONE millimeter! Now, explain what a nanometer is. Ask them, if "one hundred centimeters make up a meter, and a thousand millimeters make up a meter, how many nanometers do you think are in a meter?) Allow the students to turn to each other and share their thoughts. Then, tell the class that one billion nanometers make up a meter! Explain that a nanometer is so small that we cannot see it! Students will then go back to their table groups (or groups pre-determined by the teacher) to order them from biggest to smallest. A copy of the measurement word cards can be found in Appendix 3.

Day 5

Purpose: The purpose of this lesson is to allow students the opportunity to understand how tiny nanometers are through utilizing the height chart in nanometers available from the NISE Network. [19] Prior to beginning the lesson, print out the height chart and display it in a location in the classroom that is easy accessible to the children.

Objective: Students will measure their hands and feet in centimeters. Students will be able to convert their measurements in centimeters through use of a nanometer height chart.

Procedure: By now students have practiced and have significant exposure to units of measurement. Today, they will learn about how tiny a nanometer is. They will begin by tracing and cutting out their hands. Then, measuring their hands in centimeters from the base to the tip of the middle finger. They will record the length on their data sheet. Then, they will measure their hands using the nanometer. Repeat the process with one of their feet; measure in centimeters, then measure in nanometers and record on data sheet. Students will then answer an exit ticket question to check for understanding. Both the data recording sheet and exit ticket can be found in Appendix 4.

Day 6

Purpose: The purpose of this lesson is to introduce students to the concept of volume by allowing them to opportunity to explore how many beads of varying size will fit into the same size plastic container.

Objective: Students will determine that objects of different sizes will fill the same sized container differently.

Procedure: Give students a container (plastic container, cup, plastic Easter eggs etc.), and two different sized beads. Using one size of the beads, count how many can fit into the container. Then, using the other sized beads, fill the same container and count how many of those sized beads fit into the container. After the students have had an opportunity to count, guide a class discussion by asking prompting questions regarding how many beads of each size fit into the container.

Day 7

Purpose: The purpose of this lesson is to allow students the opportunity to explore measuring volume and density.

Objectives: Students will be able to measure a liquid into a graduated cylinder. Students will be able to conclude what happens to the water level when an object is dropped into it.

Procedure: Explain to students that volume is the amount of space that an object takes up. Practice using a graduated cylinder to measure volume. Students will practice measuring water. Ask the students to measure a certain amount of water. Then, drop a marble into the water. After the marble is dropped in, ask the students to look again at the level of water. Lead a class discussion: after the marble was dropped, what happened to the water level? (It rose, got higher, etc.) Then ask the students to determine how much higher the water level rose. (By performing subtraction). Utilize subtraction key words: "What is the difference in the water levels after you dropped the marble in?"

Day 8

Purpose: The purpose of this lesson is to give students the opportunity to explore the concepts of scale and ratio and to understand that objects can be divided in half. When an object is divided in half over and over again, eventually there will be a time when the object can no longer be divided.

Objective: Students will be able to understand that an object can be divided until it is no longer physically divisible.

Procedure:

1. Using play-dough, modeling clay, or some other flexible, pliable material, students will cut in to ten equal sections using a plastic knife. To help the students keep objects separate and equal the cutting mat may be used to help. (located in Appendix 5)
2. Then, take each section and cut into another ten sections
    a. Explain that this is 1/10
3. Repeat the process, explaining each time it is cut that it is 1/10, 1/100, 1/1000 (etc.)
4. Continue until the playdough is no longer divisible

Day 9

Purpose: The purpose of this lesson is to allow students the opportunity to see how as properties change, the volume of the object also changes.

Objectives: Students will observe the property changes required to make ice cream. Students will be able to use a thermometer to measure the temperature of the ice before and after it is mixed with the other ingredients.

Procedure: In small groups of 4-6 students, have them read the recipe for making ice cream. Before they begin, ask them to measure the temperature of the ice by using a thermometer. Record the temperatures on a board in the classroom. Then, instruct students in measuring ingredients for the ice cream. (See Appendix 6). After students have made the ice cream, measure again the temperature. Lead a class discussion about what happened to the liquid materials in the pint sized Ziploc bags?

Day 10

Purpose: The purpose of this lesson is to allow students the opportunity to have a hands on, meaningful experience with measuring temperature and allow them to begin critically thinking about the importance of temperature and its impact on the chemical and physical changes of other materials. In this lesson, students will be asked to formulate a hypothesis, test a hypothesis, perform an experiment by measuring the temperature and speed.

Objectives: Students will be able to formulate a hypothesis, and convey their hypothesis using a complete sentence. Students will be able to measure the temperature using a thermometer. Students will be able to properly use a stop watch to measure speed. Students will be able to measure water using a measuring cup. Students will be able to collect data and record observations.

Procedure: Students will have prior knowledge on what a hypothesis is and how to formulate a proper hypothesis. Pose this question to students, and allow them to answer it on their lab (found in Appendix 7): "Does temperature affect the speed that hot chocolate is dissolved?" Allow students some time to write down their hypothesis (teachers may have to guide them, use the word prediction, remind them to write in a complete sentence, check spelling, and explain why they feel that way).

Before beginning, the following materials will be needed to complete this science lab:

1. 3 heat proof mugs or containers (coffee mugs will work)
2. 3 packets of instant hot chocolate (no marshmallows)
3. 3 thermometers
4. 3 stopwatches
5. Measuring cup
6. 3 plastic spoons
7. Water
    a. Access to heat up water (microwave, crockpot, hotplate, etc).
    b. Ice-cold water (either left in the refrigerator for several hours or had ice in it that is removed before the experiment begins)
    c. Room temperature water (water that has been left out for several hours)

After students have recorded their predictions, explain that we are going to test our hypothesis by attempting to dissolve hot chocolate with three varying temperatures. One hot (define as water that has been heated), one room temperature (define as water that has been left out over-night), and cold water (define as water that comes from the fridge, or had ice cubes in it).

Begin by putting a packet of hot chocolate into each mug. Beginning with the ice-cold water, pour 6 ounces into a mug of hot chocolate mix. Immediately start the stop watch and record the temperature. Then, begin stirring the mixture continuously, until it is dissolved. Students will record how long it took to dissolve (if it did) and record what it looked like using words and as well as drawing a picture to visually represent it. Also, recording the ending temperature when the hot chocolate dissolved. Repeat this process with the room-temperature, as well as the hot water, making sure to record the results after each cup.

Day 11

Purpose: The purpose of this lesson is to compile the data from the hot chocolate lab from the previous lesson and present the data in a graph form. Students will be asked to graph how long it took each hot chocolate packet to dissolve and which temperature it was at the beginning.

Objective: Students will be able to graph how long each hot chocolate mixture took to dissolve at the varying temperature.

Procedure: Taking their data from the previous day, students will complete a graph detailing how many minutes it took each hot chocolate packet to dissolve depending on the temperature. Next, the teacher will ask comprehension questions regarding the graph that the students will complete. Lead a class discussion regarding which water temperature helped dissolved the hot chocolate packet first, and which one dissolved last. Students will complete the comprehension questions. See Appendix 8.

Assessments

The following forms of assessment will be used to measure student understanding and academic growth:

- Teacher Observation
- Checklist
- Individual Lesson assessments

Appendix 1

Standards Addressed

Common Core Standards for Mathematics

2.MD.1- Measure the length of an object by selecting and using appropriate tools such as rules, yardsticks, meter sticks, and measuring tapes. Students will be measuring objects using: rules, yardsticks, meter stick, tape measures, as well as measuring items in nanometers.

2.MD.2- Measure the length of an object twice, using length units of different lengths for the two measurements, describe how the two measurements relate to the size of the unit chosen. Students will be measuring objects in different units of measure and asked to determine which unit is bigger or smaller, and how that can be determined.

2.MD.3- Estimate lengths using units of inches, feet, centimeters, and meters. Students will be asked to measure a part of the hallway using a non-customary unit of measure, and asked to make a prediction of which unit will take the most or least to measure the hallway.

Appendix 2

Name: _____

Math Workshop Stations

Directions: At each station, look to see which measurement tool you are using. Write it in the appropriate box. Use the word box. Hint: you will use one word twice. Then, measure the object at your station and record their lengths appropriately.

Word Bank

ruler	yard stick	tape measure

Station #	Measurement Tool	Length
1		
2		
3		
4		

Appendix 3

centimeter	meter
nanometer	millimeter

Appendix 4

Name: _____

Fun with Nanometers! Recording Sheet

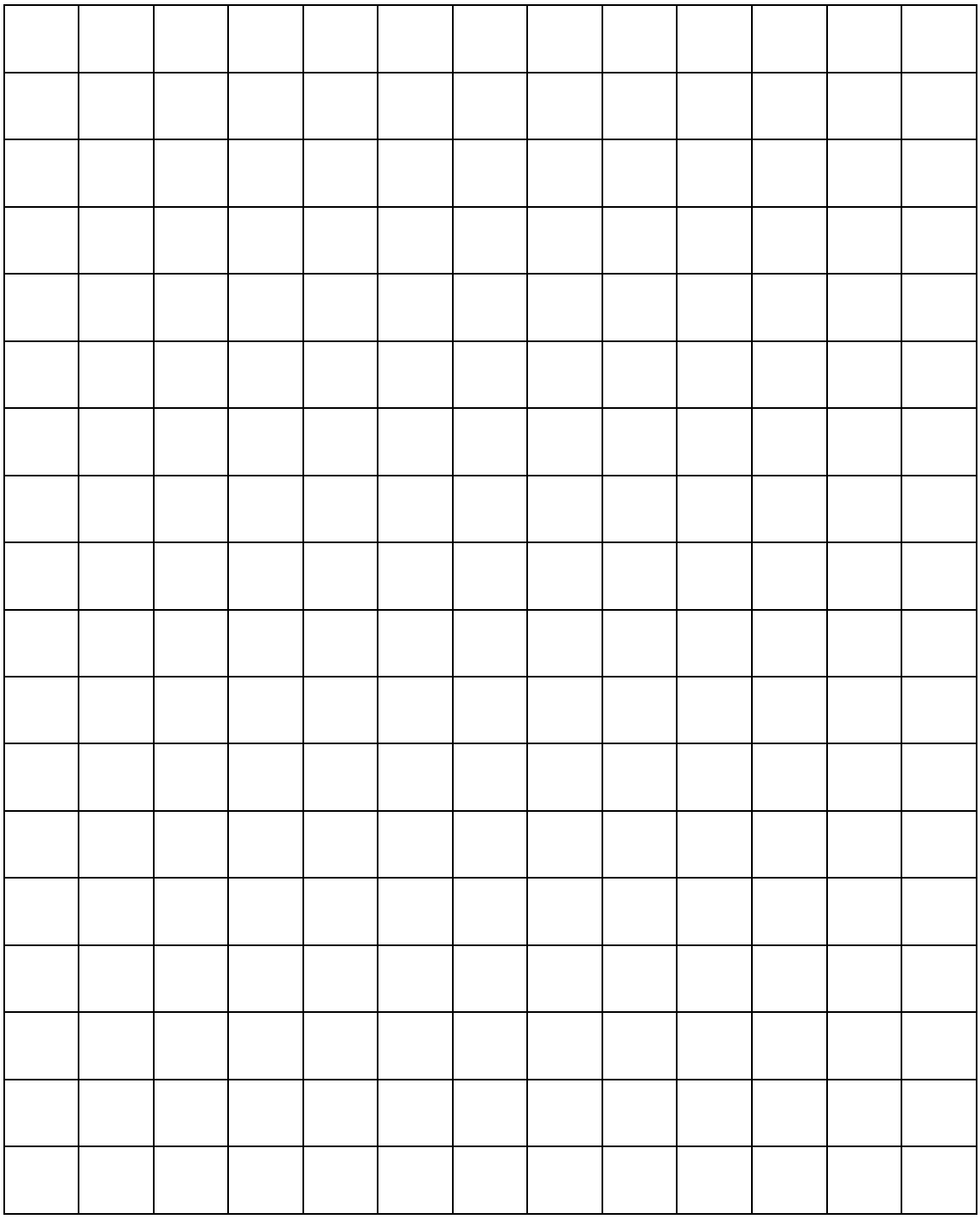
Hand	How many centimeters long is your hand? _____ cm	How many nanometers long is your hand? _____nm
Foot	How many centimeters long is your foot? _____cm	How many nanometers long is your foot? _____nm

Exit Ticket:

Read & Respond- Is a nanometer bigger or smaller than a centimeter? How do you know?

_____
_____
_____
_____
_____

Appendix 5



Appendix 6

Ice Cream Recipe

Ingredients

Ice Cubes
1 cup Half & Half
½ cup salt
2 tablespoons of sugar
½ teaspoon of vanilla
1 pint sized Ziploc bag
1 gallon sized Ziploc bag

Directions

1. Measure out 1 cup of Half & Half and add it to the pint sized Ziploc bag
2. Measure out 2 tablespoons of sugar and add it to the pint sized Ziploc bag
3. Measure out ½ teaspoon of vanilla and add it to the pint sized Ziploc bag
4. Seal the bag completely.
5. Fill the gallon sized Ziploc halfway with ice cubes
6. Add ½ cup of salt to the ice
7. Put the pint sized Ziploc bag into the gallon sized Ziploc bag
8. Seal the gallon sized Ziploc bag completely
9. Take turns shaking the bags, passing them around in the group.

Recipe from: "Make Ice Cream In a Plastic Bag" http://www.instructables.com/id/How-to-Make-Homemade-Ice-Cream-in-a-Bag/step4/Shake-it-up/1995-2016 Teachnet.com

Appendix 7

Hot Chocolate Lab

Question:

Does temperature affect the speed that hot chocolate is dissolved?

State your hypothesis below:

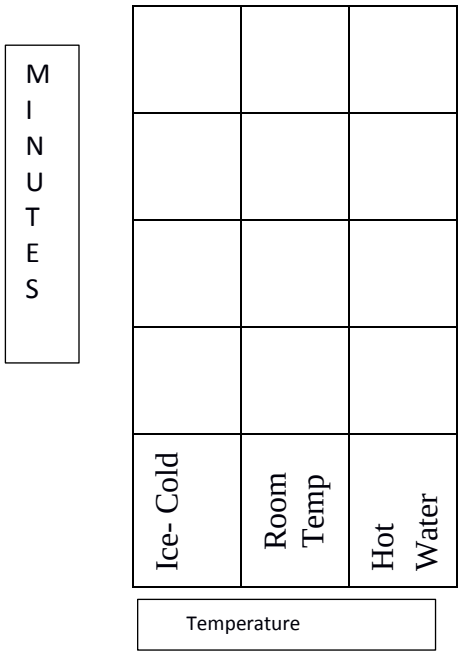
_____
_____
_____
_____
_____

Collect Data:

Ice-Cold Water	Room-Temperature Water	Hot Water
Initial Temperature: _____	Initial Temperature: _____	Initial Temperature: _____
Drawing	Drawing	Drawing
Describe what is happening:	Describe what is happening:	Describe what is happening:
Ending Temperature: _____	Ending Temperature: _____	Ending Temperature: _____
How long did it take to dissolve?	How long did it take to dissolve?	How long did it take to dissolve?

Appendix 8

Represent Data:



1. Which mug took the longest to dissolve?

_____

2. Which mug took the least to dissolve?

_____

3. What is the difference between the temperature in the ice-cold mug and the room-temperature mug?

_____

4. What is the total of all of the temperatures?

_____

Student Resources

"Make Ice Cream In a Plastic Bag" http://www.instructables.com/id/How-to-Make-Homemade-Ice-Cream-in-a-Bag/step4/Shake-it-up/1995-2016 Teachnet.com This website will be utilized in order to assist students in making ice cream

Teacher Resources

"Exploring Size-Measure Yourself" http://www.nisenet.org/catalog/ National Informal Stem Education Network, 2013. Teachers will be able to print the size chart in nanometers from this website. Additionally, this website has many other useful science activities.

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1. Martinie, Sherri. "Families Ask: Measurement: What's the Big Idea?" Mathematics Teaching in the Middle School Vol. 9, No. 8 (April 2004). Pp 430-431. Accessed 10-12-2006

2. Martinie, Sherri. "Families Ask: Measurement: What's the Big Idea?" Mathematics Teaching in the Middle School Vol. 9, No. 8 (April 2004). Pp 430-431. Accessed 10-12-2006

3. North Carolina Department of Public Instruction: *Instructional Support Tools for Achieving New Standards*. "2nd Grade Mathematics: Unpacked Content." http://www.ncpublicschools.org/docs/curriculum/mathematics/scos/2.pdf (July, 2013)

4. Martinie, Sherri. "Families Ask: Measurement: What's the Big Idea?" Mathematics Teaching in the Middle School Vol. 9, No. 8 (April 2004). Pp 430-431. Accessed 10-12-2006

5. Martinie, Sherri. "Families Ask: Measurement: What's the Big Idea?" Mathematics Teaching in the Middle School Vol. 9, No. 8 (April 2004). Pp 430-431. Accessed 10-12-2006

6. School Improvement Plan. October 26, 2015. Accessed October 13, 2016. http://schools.cms.k12.nc.us/barringerES/Documents/Barringer SIP 2015-2016.pdf.

7. School Improvement Plan. October 26, 2015. Accessed October 13, 2016. http://schools.cms.k12.nc.us/barringerES/Documents/Barringer SIP 2015-2016.pdf.

8. Martinie, Sherri. "Families Ask: Measurement: What's the Big Idea?" Mathematics Teaching in the Middle School Vol. 9, No. 8 (April 2004). Pp 430-431. Accessed 10-12-2006

9. Martinie, Sherri. "Families Ask: Measurement: What's the Big Idea?" Mathematics Teaching in the Middle School Vol. 9, No. 8 (April 2004). Pp 430-431. Accessed 10-12-2006

10. Martinie, Sherri. "Families Ask: Measurement: What's the Big Idea?" Mathematics Teaching in the Middle School Vol. 9, No. 8 (April 2004). Pp 430-431. Accessed 10-12-2006

11. Browning, Christine, Alden J Edson and Patrick M Kimani. "Mathematical Content Knowledge for Teaching Elementary Mathematics: A Focus on Geometry and Measurement." Mathematics Enthusiast (August 2014) Vol 11 Issue 2 p. 333-383.

12. Brehelin, Danie, Helene Merle and Valerie Munier. "Teaching Scientific Measurement and Uncertainty in Elementary School. International Journal of Science Education (2013). Vol 35 Issue 16. Accessed 10/12/2016

13. Brehelin, Danie, Helene Merle and Valerie Munier. "Teaching Scientific Measurement and Uncertainty in Elementary School. International Journal of Science Education (2013). Vol 35 Issue 16. Accessed 10/12/2016

14. Brehelin, Danie, Helene Merle and Valerie Munier. "Teaching Scientific Measurement and Uncertainty in Elementary School. International Journal of Science Education (2013). Vol 35 Issue 16. Accessed 10/12/2016

15. Martinie, Sherri. "Families Ask: Measurement: What's the Big Idea?" Mathematics Teaching in the Middle School Vol. 9, No. 8 (April 2004). Pp 430-431. Accessed 10-12-2006

[16] Guillaume, Andrea. "K-12 Classroom Teaching: A Primer for New Professionals 2nd Edition" (New Jersey: Pearson Education, Inc. 2004)

[17] Guillaume, Andrea. "K-12 Classroom Teaching: A Primer for New Professionals 2nd Edition" (New Jersey: Pearson Education, Inc. 2004)

[18] Guillaume, Andrea. "K-12 Classroom Teaching: A Primer for New Professionals 2nd Edition" (New Jersey: Pearson Education, Inc. 2004)

[19] "Exploring Size- Measure Yourself" last modified September 2013. http://www.nisenet.org/catalog

Bibliography

Brehelin, Danie, Helene Merle and Valerie Munier. "Teaching Scientific Measurement and Uncertainty in Elementary School. International Journal of Science Education (2013). Vol 35 Issue 16. Accessed 10/12/2016 This resource gave valuable information on the importance of teaching measurement using hands-on strategies and not paper-pencil traditional methods.

Browning, Christine, Alden J Edson and Patrick M Kimani. "Mathematical Content Knowledge for Teaching Elementary Mathematics: A Focus on Geometry and Measurement." Mathematics Enthusiast (August 2014) Vol 11 Issue 2 p. 333-383. This resource discusses ways to integrate measurement into other content areas.

Larken, Kevin, Kaeth Perez, and Darcy Webb. "Spring Fever." Teaching Children Mathematics Vol 10 No 8 (April 2004), p 408-409. This article discusses the importance of teaching measurement in an early education setting and its potential implications on middle school and high school mathematical development.

Martinie, Sherri. "Families Ask: Measurement: What's the Big Idea?" Mathematics Teaching in the Middle School Vol. 9, No. 8 (April 2004). Pp 430-431. Accessed 10-12-2006 This article gives information on the importance of measurement in the elementary classroom and ways to integrate it in the classroom and at home.

North Carolina Department of Public Instruction: *Instructional Support Tools for Achieving New Standards*. "2nd Grade Mathematics: Unpacked Content." http://www.ncpublicschools.org/docs/curriculum/mathematics/scos/2.pdf (July, 2013) This document from the North Carolina Department of Public Instruction gives detailed description of the skills and standards 2nd graders should learn in regards to measurement.

Pienta, Norbert J. "The Role of Elementary and Secondary Schools and Their Teachers of Chemistry." Journal of Chemical Education (January 2014) Vol 91 Issue 1 p 1-2. This article gives information on the role of measurement in science in the elementary classroom.

Wickstrom, Megan H. "Volume is a Treat." Teaching Children Mathematics (November 2015) p 264. This article gives information on how to include measuring volume in the elementary classroom.