

Who Measures What in Our Neighborhood?

K-1 Classroom

Phase 2 - Inquiry

Pursuing Our Questions

Data Collection, Analysis, and Synthesis, and Evaluation



The meteorologist explains the thermometer and barometer inside the box.



The students make field sketches of an anemometer.

Once the students formulated questions for measurement in Phase 1, Phase 2 began with the students investigating and gathering data to answer their questions. The students gathered data by going on field trips (site-visits), exploring artifacts first-hand, interviewing experts, observing, using the Internet, reading books, and designing questionnaires. They recorded their data by sketching, drawing, taking notes, videotaping their experiences, and taking photographs. They always predicted what they might find or see before their field visits and before they spoke with the experts so they could compare their current understandings with what they had learned. They, observed, hypothesized, theorized, tested, analyzed, and evaluated their data. They shared their findings at group meetings. Parents shared their expertise, answered surveys, and contributed related artifacts for study.

Field Work

What tools are used for measuring?

To begin to answer their question, “What tools are used for measuring,” students gathered measuring tools from home and around the school. The teachers wanted students to gain awareness that measurement takes place at school and at home. The first place students “visited” was their own classroom. They continued to explore the measuring tools in the classroom for five months!

Their collection of artifacts that were either measuring tools or involved the use of measuring included teaspoons, measuring cups, trundle wheel, watches, clocks, a quilting template, a sewing machine, yard sticks, a fabric cutting board, antique spring scale, balance scale, doctor's scale, a bungee cord, several different thermometers, money, calibrated weights, tape measures, an oil stick, and a tire air gauge. They also found that people use body parts and other non-standard units as reference points to measure. They compared standard to non-standard units.



Using non-standard measurement
to measure the length of the floor.

One child announced to the class that his gerbil had babies. He told them how he measured the babies with his finger and the other students questioned his measuring technique.

JN: My gerbils had babies before I came to school today. I put my finger beside one of them and its body AND tail was as long as my first finger to the knuckle.

MW: Why didn't you put a ruler in to measure?

JN: Oh... The mom wouldn't have liked that. My mom said that I could bring them to school to show you when just the body is to the knuckle of my first finger – not including the tail.



JN shows the students
how big the gerbils were
compared to his fingers

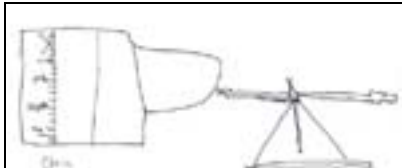


Students use a ruler to
measure the snow.

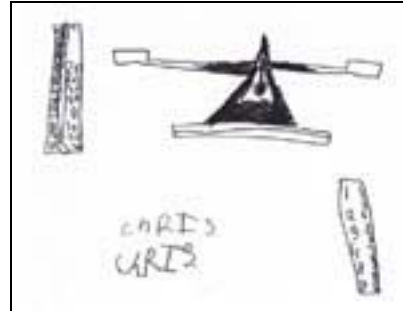
Throughout the project students used standard and non-standard measurements and learned to distinguish them.

How do measurement tools work?

As students measured, they observed closely and investigated, how the measurement tools worked. They made time 1 and time 2 observational drawings of items of interest.



Time 1 Drawing – 3/15/02
CS looks at measuring
tools and makes an
observational drawing of a



Time 2 Drawing – 3/27/02
CS makes a more detailed
drawing of the balance

The purpose of doing a second observational drawing was to increase their ability to observe carefully and integrate more details into the drawings. In measuring long areas with a ruler, students practiced working with a partner to put their finger at the end of the measuring tool and then advance the ruler.

A mechanical engineer helped answer questions generated during phase 1, “How do you make a measuring tape work, and how does a scale work?” He showed the mechanism inside the measuring tape that makes it return when the button is pushed. He demonstrated how the spring scale bounces back by putting a bungee cord next to a ruler. He distinguished between different types of scales and explained the way the fulcrum works in a balance scale that measures heavy items. He showed a food and stamp scale used to weigh light items. He also answered, “How do you measure a TV and computers, and how do you measure wood, and wire?”



The engineer explains the way the
balance scale works.

What things get measured?

To answer the question, “What things get measured,” the students used their collection of measuring tools to measure items found in the classroom including themselves. They predicted and recorded what they thought the measurement would be and then proceeded to measure.

They found and measured the following:

- Each other’s height, weight
- Parts of body: circumference of waist, knee, wrist, ankle, neck, head, etc.
- Chicks: height and weight
- Carpet length: feet – standard, non-standard
- Room length, width, and area – standard, non-standard
- Ceiling to floor – comparison of each room
- Books
- Papers
- Pencils, markers, staplers, and crayons
- Weighed:
 - 100 pencils
 - 100 crayons
 - 100 beans
 - 100 graham crackers
 - Chicken feed
- Length of window standard, non-standard
- Tables and chairs – height, length, width - standard, non-standard
- Measured ingredients, time and temperatures to cook
- Depth of snow
- Depth of rain puddle
- Costumes
- Days to an event – chicks hatching
- Number of chicks hatched
- Amount that the chicks ate, drank and spilled
- Size of playground for an obstacle course
- Plastic animals
- Blocks
- Computers
- Wood
- Wire
- TV



MW measured DM while she tried to stand very still.



KC measured the length of the plastic animals on the toy shelves. Her data shows

Why do we measure?

All through the project, students discussed the question, “Why do we measure?” They realized that they use measurement in all aspects of their day. For example, they checked the thermometer to determine whether they could go outside and what to wear for recess. Their understanding of temperature expanded with the concept of wind chill. Students asked the teacher daily if the temperature was above 20 degrees so they could go outside for recess. They asked for the wind speed and direction as well. Together the teacher and students read the thermometer on the playground and verified their findings by checking the weather service on-line. Students recorded the daily temperature and graphed it daily for a two-week period.

In preparation for the annual art exhibition at University Primary School, a group of students paced their steps to map out a course for parents to follow and drew a map using their measurements. They used a stopwatch and trundle wheel to design an obstacle course.

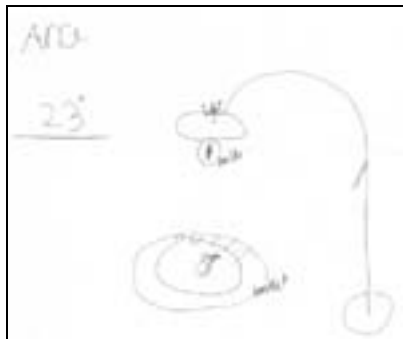


BK counted his steps down the hall and to the art exhibit and made this map.



AC practices using a trundle wheel to measure the length of the floor.

The teacher provided an additional context to consider reasons why people measure. On April 23rd, students counted two-dozen eggs and predicted what conditions they thought eggs would need to hatch.



AH predicted that the chicks will hatch in a basket with a light bulb at 23 degrees.



HB predicted the habitat for hatching eggs should be a cushion with a light bulb at 10 degrees.

The teacher introduced the incubator as the habitat for keeping the eggs warm. After school, she placed the eggs in the incubator. Throughout the incubation period, students measured the temperature of the incubator by checking the thermometer inside of the incubator. They kept track of the incubation period by marking days off on the calendar. While waiting for the chicks to hatch, students cooked with eggs and experimented with measurement. They made meringue cookies and beat egg whites until they were stiff. The animal scientist explained that when they beat the egg whites, they trapped air inside and the egg whites became fluffy and bigger than their original liquid state. They noticed with the air trapped in the egg whites that it took more room in the measuring cup. Then they wondered if egg yolks when beaten would also take more or less room in the measuring cup than egg whites. They conducted their own experiments.



HB studied the incubation calendar made by a first grader.

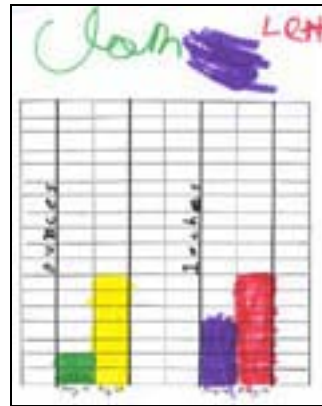


JK studied the egg yolk experiment.

Once the chicks started hatching, they counted many times a day the number of chicks that hatched, watched the thermometer in the brooder box and measured the space in the brooder box to make sure there would be enough area. After the 16 chicks were 24 hours old, they were strong enough to be held. The students recorded their growth daily by measuring their height and weight and by making observational drawings.



The assistant teacher holds the chick on the scale while KC reads the weight.



LS graphed and compared the weight and height of one chick from the second day of birth to the last day of school.

Students also recorded the amount of food and water the chicks ate. The chicks drank and spilled a pint of water in the morning and another one at night the first week. The second week, they drank a gallon of water morning and night. The children thought five pounds would be enough food. The chicks finished five pounds in one week. The next size feed bag was 50 pounds that cost \$8.90. The chicks had eaten approximately half of the food by May 30, the last day of school. This was more than the students predicted they would need to feed the chickens. Taking care of the chickens provided authentic opportunities for students to use measurement tools and to understand the importance of measurement.

Who measures what in our neighborhood?

Students had a solid grasp of all of the measurement that takes place in the classroom and wanted to explore their question from Phase 1, "Who measures what in our neighborhood?" First, they predicted all the ways they thought people measured in and around the school building.

| Predictions | How many saw it |
|------------------------------|-----------------|
| Paper being measured | 11 |
| Measuring how much fish food | 0 |
| Measuring juice for snack | 0 |

| | |
|---|----|
| Measuring seeds so that you know where to put them | 0 |
| Measuring work - counting papers | 0 |
| Measuring wood | 0 |
| Measuring to cook something | 9 |
| Measuring wells for water | 0 |
| Measuring how much popcorn for snack | 0 |
| Measuring light bulbs | 0 |
| Measuring pond water | 0 |
| Measure food for right amount for all kids | 1 |
| Measure granola bars (how much they weigh) | 9 |
| Measuring to make sure that lights last for the day | 0 |
| Measure how tall we are | 3 |
| Measure the playground | 0 |
| Measure water for plants | 0 |
| Measure how many papers she worked on | 1 |
| Measure how far they can walk | 0 |
| Measure chairs to see how big they are | 0 |
| Measure the lines on paper | 11 |
| Measure to see if it is safe for a tree to be cut | 0 |

Each child selected one of the items from the list to draw. The teacher used their drawings to make a sheet for data collection. Students walked around the Children's Research Center, the building that houses University Primary School, and made tally marks on their recording sheet every time they saw someone measuring or a measuring device. Later, the children analyzed the data that they had collected on their tally sheets. They interpreted the information and made a bar graph to show what they had seen. They communicated the results to the teacher and noted some mathematical relationships. During these individual conferences, the students noticed that they had not predicted very many of the items that they saw. Consequently, they had to draw a quick sketch of what they were seeing in the margins and tally mark there.



JC tally sheet indicates items that she saw on her tour around the school.



JC graphed her data for other students to see.

The teacher took the students on a walk around the outside of the school. The students were curious to know if people were measuring in the nearby buildings. Some students had knowledge of neighboring sites from last year's studies about communication and construction. To add to the students' common experiences, the teacher and her assistants planned a whole group field trip to the neighboring Atmospheric Environment Section of the State Water Survey and to the Fire Service Institute.

In early March, the students wrote questions for a meteorologist at the State Water Survey. They predicted how they thought he would answer their questions.

| | Questions | Predictions | Findings |
|-----|--|--|---|
| AH: | How do you know the temperature? | I think you go out and guess. | The meteorologist has a lot of machines to help. He has a rain gauge and a board with a flag on it. |
| NB: | How do you measure the weather? | Well, we'll take a thermometer outside. | A thermometer is outside all the time in a wooden box. |
| BK: | How do you measure how fast the wind's going? | I think you use an odometer. | It's called an anemometer. |
| MW: | How does the weather vane work? Does it measure? | It has a little marker thing that points to the weather and you read what it says. | It looked like an airplane without wings and it points to the direction of the wind. |
| KC: | How do you measure weather? | I think they attach a big balloon to a little box. | We saw a rain collecting tube and an air pollution-measuring machine. Sometimes they send up balloons. Sometimes he goes up in an airplane. |

The students came back to school and made representations of the measuring tools that they had seen. Some used clay to make their models. Students shared the answers to their questions and emailed the experts to clarify any misunderstandings. One student wanted to know why snow comes down as snow and not rain. The meteorologist emailed back, "If you do not have a layer of warm air above you, the snow doesn't have a chance to melt, so it comes down as snow."



SD represented a snowboard with a flag and an anemometer.



After returning from the Water Survey field trip, HB emailed the meteorologist an additional question.

Students were very excited about visiting Fireman Eddie and the fire truck at the Fire Service Institute. Children formulated questions and made predictions of the answers. Students came back to school wanting to represent a fire truck out of boxes and junk. They worked carefully to measure the wheels, the ladder, the gauges, and the hoses. They used digital photographs to enhance their representations of all of the instruments and gauges seen on the fire truck dashboard. Their fire truck became a featured product of the culminating event.

To continue the in-depth study, students signed up for teams to investigate other neighbors around the school. The teachers arranged site visits to the Ground Water Section at the State Water Survey, the Illini Credit Union, the ceramics studio, and the University of Illinois sheep farm.

Children collected their data on field site visits. They each had a clipboard with their question, and blank paper for observational drawings. They interviewed the expert and made field notes to remind them of the answer to their question.

Back at school, students made representations of the measuring instruments that they had seen. The teachers made digital pictures available to augment their field notes and to assist their memories.

The head teacher placed the digital photos in a strategic position near the students working. She asked them to look at the picture frequently to make the representation as realistic and as accurately as possible. In one instance, students painted the money counter that they saw at the Credit Union red. Other students who had seen the photograph questioned them about their choice of color. The photograph showed the money counter a gold color and the students had painted it red. After the group discussed their discrepancy, the students went back and changed the color.



This is the digital photograph of the money counter at the Credit Union.



These boys are coloring their representation of the money counter red instead of yellow.

Students went to the Ground Water Section of the Water Survey to find answers to what people used to measure water. Students learned new vocabulary words such as coil and baler on this field trip.



The expert at the Water Survey demonstrated a coil machine to measure water in a well.



MB's representation of a coil machine.

Interviewing Experts

Parent experts included an animal researcher, a potter, a pilot, seamstress, a pet owner, and a father who brought his car to show the children what you measure in a car. Children wrote questions to ask the experts what, why and how they measure. They predicted what they thought the experts would say to answer their question. They listened to the experts, asked general and specific questions.

The animal researcher explained how she measures piglet milk consumption. She measures the pigs before and after they drink from the mother. The students questioned her about how she weighs the wiggly piglets. She told them that she measures herself first and then gets on the

scale with the piglet and weighs both of them together. She subtracts her own weight to find out how much the piglet weighs. She told the students that the piglets drink a large quantity of milk in a short amount of time.

The potter introduced the students to calipers. Students wanted to know how she measured around her pots because rulers were straight and pots are curved. She also told the students that they use non-standard measurements to tell if the pot is dry. She put one wet pot and one dry pot up to her cheeks and said that she could feel the difference. The teacher went around to all of the children so that they could feel the difference between the pots too.

A parent who was a pilot showed the sectional maps that he uses. Students also worked with maps and globes to better grasp longitude and latitude. After his visit, several students wanted to incorporate what they learned about maps into a mural for Phase 3.

The seamstress helped students design and sew individual pillows and created a class quilt. She introduced students to a quilt template, a fabric cutting board, and showed students how she measured thread and fabric. She demonstrated the use of nonstandard measurement in sewing. She held thread from her nose to the end of her outstretched arm and told students that was how she knew she had approximately one yard of material or thread.

The question, what kind of measuring does a car tell a driver prompted a parent to bring a car to the school parking lot. He demonstrated the oil stick and talked about pounds per square inch measured by an air gauge. The teacher showed the students all of the gauges on the dashboard.



One student was so engrossed with the topic of measurement that she invited a friend of her parents who was a food inspector to visit the classroom. He talked about how he inspects restaurants and checks for a healthy environment for preparing and serving food. The students asked him what he measured? He said that he checks the temperature of the freezers, refrigerators, and ovens to make sure that food is stored and cooked correctly so germs and bacteria do not grow.

As the year came to a close, students wanted to share the measurement project with parents, family and friends. They moved on to Phase 3 of the project as they designed ways to discuss and share what they learned about measurement.