

Bemidji State University

**Data Investigations
Assessments in the Math Curriculum**

**Summer Math Institute
Summer 2007**

Grades 1 and 2

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Minnesota Academic Standards in Mathematics that these lessons are addressing:

Grade 1: Number & Operation

1.1.1.7 Use counting and comparison skills to create and analyze bar graphs and tally charts.

Grade 2 Number & Operation

2.1.1.6 Use addition and subtraction to create and obtain information from tables, bar graphs and tally charts.

Minnesota Academic Standards
May 19, 2003

Probability and Statistics

Grade 1

a) Data Analysis, Statistics and Probability

i) Data and Statistics Standard: Gather and record data in real-world and mathematical problems.

(1) Gather and record data about classmates and their surroundings in a simple graph.

(2) Identify patterns in simple graphs.

Grade 2

a) Data Analysis, Statistics and Probability

i) Data and Statistics Standard: Collect and represent data in real-world and mathematical problems.

(1) Collect and record categorical data.

(2) Create pictographs and real-object graphs to represent data.

(3) Identify patterns in graphs or data sets.

Executive Summary

We have designed a series of lessons integrating children's literature with math activities. The first lesson begins with a bioglyph activity, where the children learn to collect, display and interpret data.

During the second lesson we presented the book The Great Graph Contest in its entirety. This book introduces the students to bar graphs, pie charts, Venn diagrams and quantity graphs. It also shows how to collect record and interpret the data.

Then we have a series of lessons, each introduced by a story book, concentrating on one type of graph. Again collecting, recording and interpreting data is stressed. These lessons also refer back to the appropriate pages in the book The Great Graph Contest.

This unit could be presented in its entirety as written to introduce and teach the various graphs. The unit may be presented as a review at the end of the school year for first graders or as a review at the beginning of the year for second graders.

They may also be presented periodically throughout the year. The first lesson would be presented in early September to enable the students to learn about each other. The other lessons could be used to replace or reinforce the math curriculum when the various types of graphs are presented.

The lessons are introduced to the entire group. The majority of the graph work is done in small groups, and following each type of graph presentation, each child is asked to draw their representation of the small group/large group graph.

They are also lessons that could be easily used and/or adapted with special education students in a pull-out, small group model with a special education instructor.

Scarecrow Glyph

Objective: This activity and discussion will need two or three days to complete in a classroom setting. Students with special needs and in a pull-out setting may be able to complete the lesson during one session. To collect, display and interpret data. Students create glyphs in which each detail represents a unique bit of information about them. Once the glyphs are created and displayed, the students will analyze and interpret each others glyphs, giving them opportunities to communicate their mathematical thinking orally and in writing. It is also a way for the students to get to know each other at the beginning of the year.

Materials: Line drawings of scarecrow pants, shirts, hats and faces; colors or markers, scissors; etc. In first grade you may want each student to paste their items on a large sheet of construction paper, and use color crayons for hair. You may choose to have items such as yarn for second graders to create hair, sticks for legs, etc.

Launch: Teacher would have prepared their own glyph and show it to students. She will tell the students that this tells them a story about her. Short discussion follows about what information we could obtain from looking at this glyph. We are going to each make our own glyph and tell our own story.

Explore - Pass out line drawings. Emphasize following instructions carefully as each student makes their glyph. Second grade teachers may consider having their students follow written instructions rather than verbal instructions.

Hat (Gender)

Rounded hat - girl

Pointed hat - boy

Color hat your favorite color

Hair (How I feel about math):

I love math – yellow hair

I do not like math – brown hair

Eyes (Where we live): Choose brown, blue or green depending on eye color.

Triangle – live in town -

Round: live in country

Nose (Favorite subject):

Triangle – Science

Rectangle – Math

Circle – Reading

Arrow – Spelling

Mouth (Where we were born):

Smile – Born in Minnesota

Frown – Born somewhere else

Buttons on shirt (one button for each sibling):

Pink – Sisters

Blue – Brothers

Patches (one patch for each pet):

Orange – cat

Purple – dog

Green – fish

Yellow – Hamster, gerbil, guinea pig

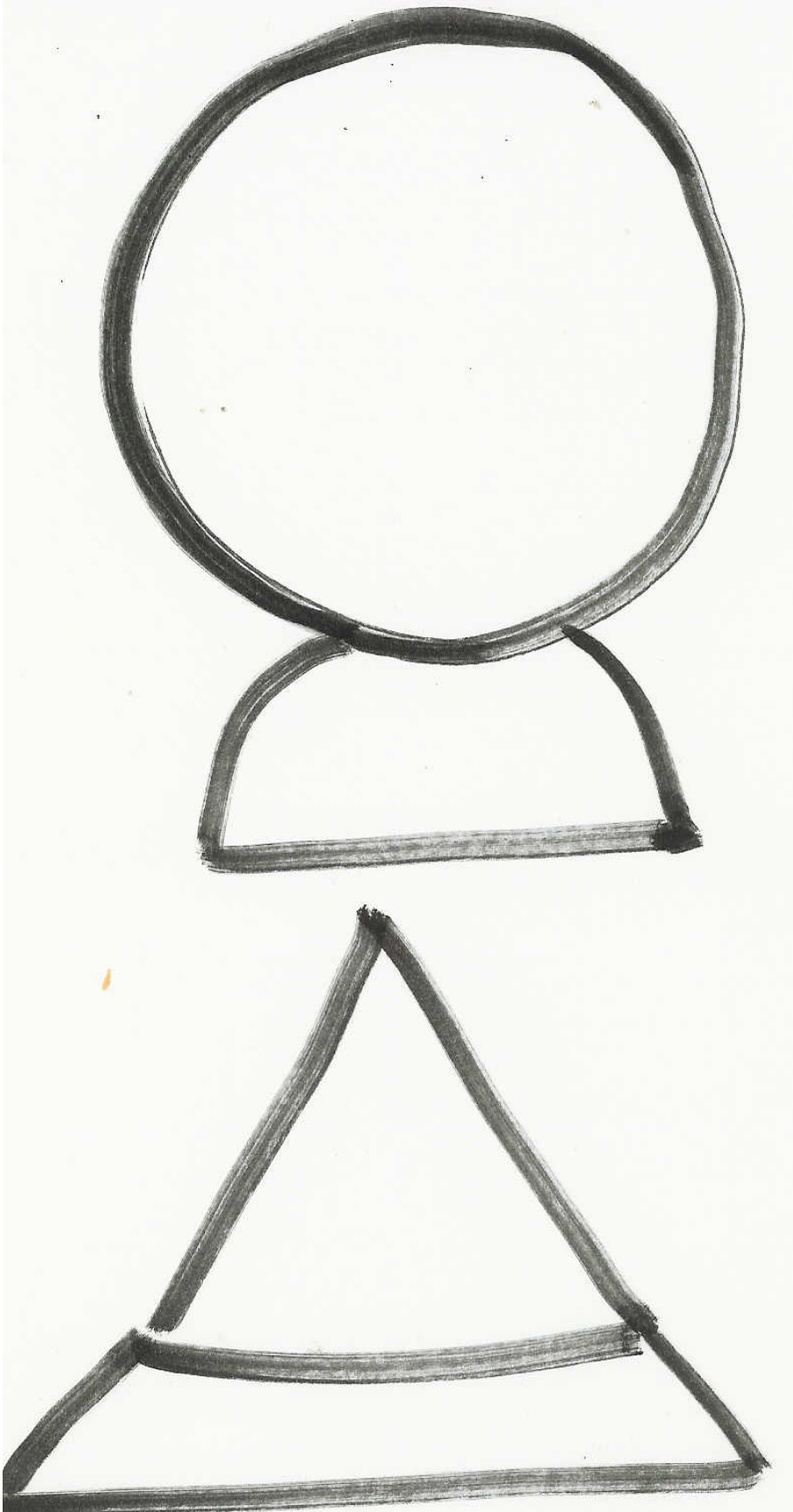
Red - Horse

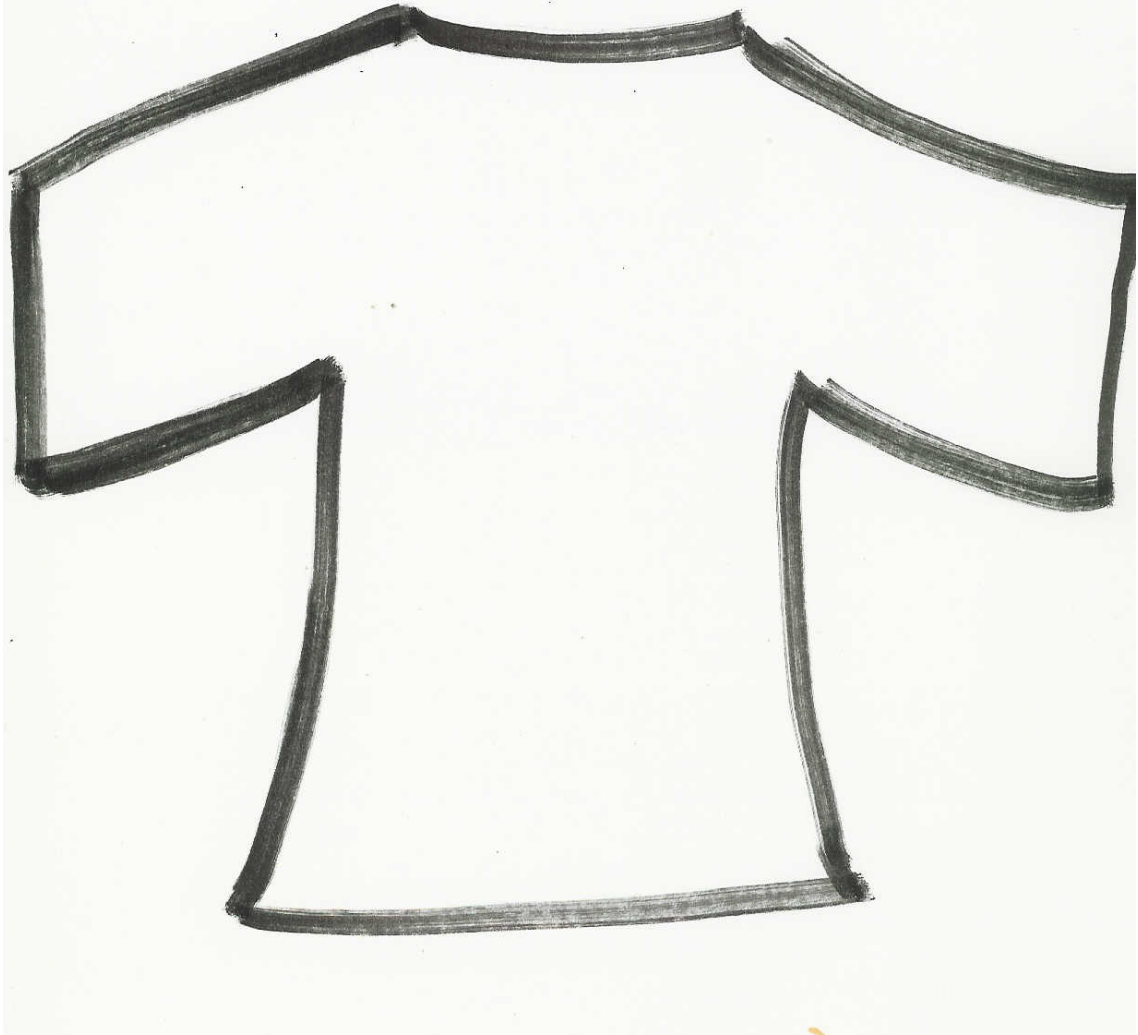
Black – any other pet

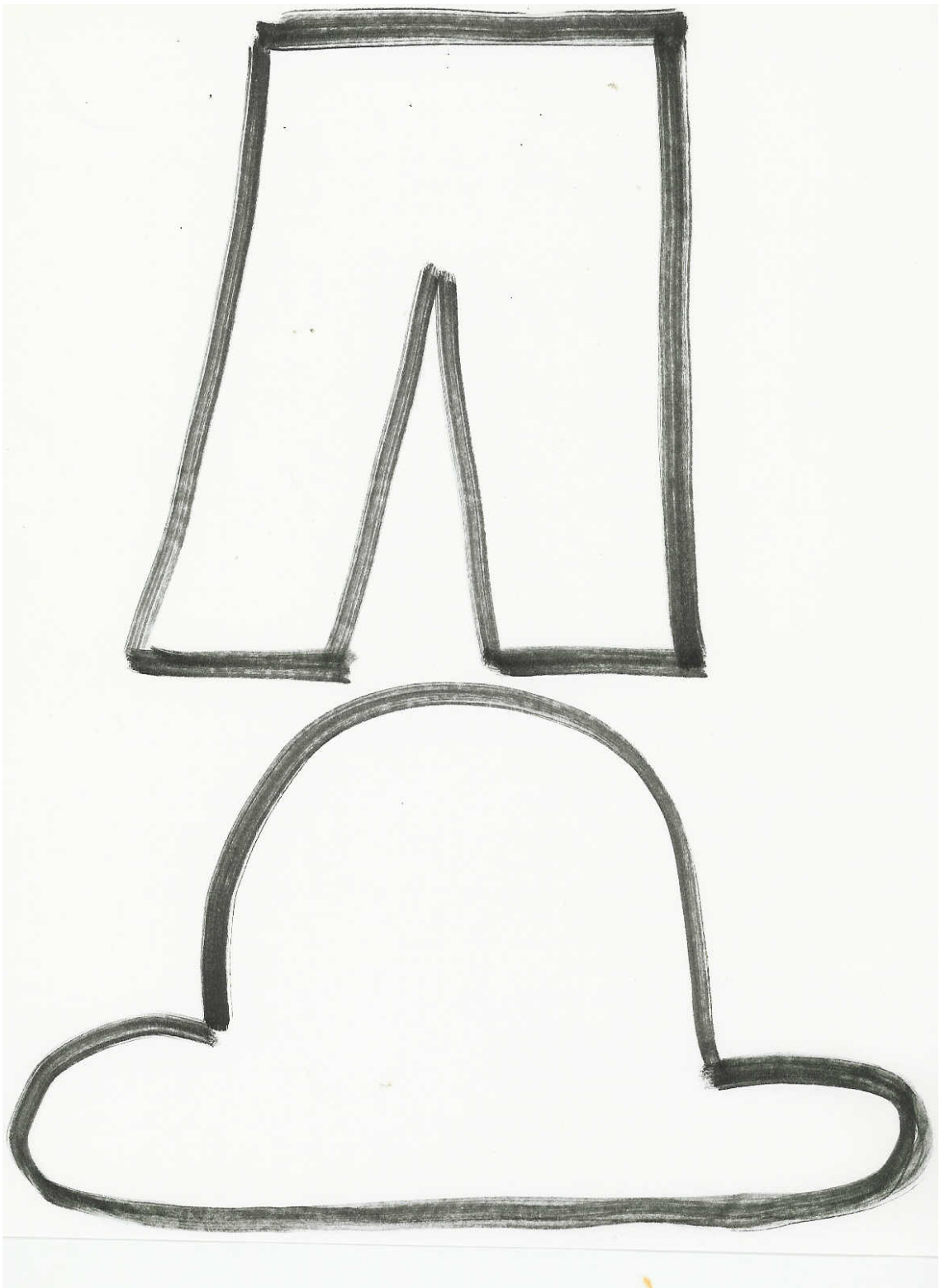
Share: Collect glyphs from all students. Taking one glyph at a time, discuss the attributes and have students decide who and why this represents a classmate. After each child's glyph is discussed, place on bulletin board or wall as a display, along with child's name.

Summarize: The main point of this lesson was to collect data, analyze data in a representational form, and to interpret results to solve the problem. It also enabled the children to learn about each other beyond name.

Citation: Glyphs! Data Communication for Primary Mathematicians by Susan R. O'Connell







The Great Graph Contest

Objective: To find out what the students already know about graphing. Are any students familiar with the term graph, Venn diagrams, circle graphs, bar graphs, how to collect information, how to sort information, etc.? This first lesson is a general introduction to the various types of graphing, building interest, etc.

Materials: The Great Graph Contest by Loreen Leedy.

Launch: In second grade you may want to begin with a written pretest to find out how much knowledge about graphing they already possess. This could be a series of questions including: What is data? How can you collect data? What is a graph? What is a quantity graph? What is a bar graph? What is a circle graph? What is a Venn diagram? Is it easy to compare data in a graph? Do you enjoy collecting data? Do you enjoy making graphs?

For first grade students the pretest would be part of the verbal discussion before and during the reading of the book. The teacher would take anecdotal notes about what each child already knows about graphing.

Explore: Introduce the book by showing cover. Ask students what they think the book is about? How do they interpret the picture on the front? Read the book, stopping wherever appropriate to discuss the pictures and the story information.

Share: The majority of the sharing will take place during the reading of the book.

Summarize: Teacher observation as to how much interest was shown by each individual student. If pretest was given, how much prior knowledge did each student present? This book will be used as a reference throughout the unit (year) giving examples of different types of graphs as each is introduced to the class.

Citation: Leedy, Loreen, The Great Graph Contest, A Holiday House Book, 2005

Tally Mark Graph

Objective: Use tally marks to gather and sort information from our scarecrow glyphs, as discussed in book The Great Graph Contest. Students learn to record data using tally marks in groups of 5, count by 5's and compare data.

Materials: Individual glyphs which are on the wall or bulletin board and worksheet for each student.

Launch: Using book Math for All Seasons, pages titled Fall Finale, introduce grouping by five and discuss how that is implemented in tally counting. Practice this on chalk board to be sure each student has an understanding of how this is done.

Explore: Pass out worksheet. Individually or in small groups, complete the worksheets using the data from the glyphs.

Share: Take turns explaining to class what answers they have and how they arrived at them, including which grouping has the most and least data.

Summarize: Teacher analysis as to if student were able to tally information correctly, and explain what they did to the group as a whole.

Citation: Tang, Greg. Math for All Seasons, Scholastic Inc. 2002

Survey of Favorite Subject and Eye Colors

Complete this survey by interviewing all your classmates. Remember to begin with yourself.

Favorite Subject

	Tally Marks	Total
Science		
Math		
Reading		
Spelling		

Eye Color

	Tally Marks	Total
Brown		
Blue		
Green		

Complete the following:

1. Which subject do most students like? _____
Least liked? _____

2. Which eye color is most common? _____
Least common? _____

Quantity Graph

Objective: Use a quantity chart to gather, sort and exhibit information as discussed in book The Great Graph Contest. This lesson will need two or three class periods to complete.

Materials: Book Everybody Needs a Rock; students will each bring a special rock for the second class period. Also needed is a large sheet of construction paper and sticky notes.

Launch: Read book to group.

Explore: Discuss book. This discussion could lead into discussion about other special items that the students possess. Go over rules about finding their own special rock with directions to bring rock the next day.

2nd Day Launch: Refer back to book The Great Graph Contest, pages 8 and 9. Reread these pages and discuss.

Explore: Use a large sheet of construction paper divided with a line down the middle. Label two 'sticky notes' with words rough and smooth. Have each child decide which group their rock goes in and explain to class why they chose that section. Make a tally chart on chalkboard as a group showing information about the rough and smooth rocks.

Challenge students to come up with other ways they can group the rocks. (Example: color, size, weight). Label sticky notes with appropriate categories. Again have students place their rock and explain why they chose that category. Make tally charts for each category.

Share: Discuss how many different ways they found to group the rocks (collect data).

Summarize: Did the students properly sort and label their data? Was each child able to explain how they chose the categories to place their rocks, and were they accurate choices?

Citation: Baylor, Byrd. Everybody Needs a Rock, Aladdin Paperbacks edition, 1985.

Name _____

Draw a representation of our class quantity graph.

Check List for making a new quantity graph

_____ **I am not sure how to begin a graph of my own.**

_____ **I know how to collect data to make another graph.**

_____ **With a little help I could put my data on a graph.**

_____ **I could put my new data on a graph.**

_____ **With a little help I could collect data and make a new graph.**

_____ **I could collect data and make a new graph.**

_____ **I can explain my graph data to others.**

Animals in the Neighborhood – Bar graph

Objective: Students will construct categories to describe data, and create bar charts. Students will articulate clear definitions of categories. Students will organize and display categorical data in a bar chart. This lesson will take place over two or three days.

Materials: Books: Splash and The Great Graph Contest. Sticky notes or index cards, chart paper, large sheets of paper, crayons or markers and student worksheets.

Launch: Read Splash aloud.

Explore: On the blackboard, make a list of the animals in the backyard and count the animals. Pass out the worksheet and have students cut out the animals. Reread the book and the students follow along, doing the math (addition and subtraction) as it takes place in the book.

Sharing: Students will share their results with the class following the rereading of the story and see if they all arrived at the same data.

Summarize: Through teacher observations were students able to follow the story line and complete math computations correctly.

Launch: (2nd day) Refer back to book The Great Graph Contest, pages 22 through 27. Reread these pages and discuss Bar charts.

Explore: Today we will be collecting data by thinking about what we already know about the animals that live in our neighborhood. Think back to when you have walked around your neighborhood. What animals have you seen that live around you? Some animals are easy to see and some animals are hard to see. What animals do you see in the winter? What animals do you see in the summer? What animals are easy to see? What animals hide or are very tiny and you have to look carefully to find? List all the animals that the children have named. There may be some animals students have seen whose names they don't know. Find some way to identify them – maybe other students know what they are, or make up a name for them (silver bathtub bug, little yellow bird).

After creating list, then talk about how animals move differently. As a class make a list of the different ways animals move (walk, fly, crawl, swim, hop, etc.). Now we are going to divide our list of animals by how they move.

Separate students into groups of 4 or 5. Each group will make a chart showing how animals move. They may decide which categories of movement they will use on their chart, utilizing the class list of movements, or changing and adding some of their own ideas. Provide each group with sticky notes or index cards so each animal may be written down separately.

Each group also needs a large sheet of paper on which to record their groupings. Let students experiment with different arrangements for their categories. Encourage students to sort the animals in whatever ways make sense to them and to articulate why they are putting certain animals into certain categories. It's important that students discuss their reasoning with one another. Students may not always agree, but they should be encouraged to resolve differences by clarifying the definitions of their categories.

Sharing: Pass out worksheets and have each child (or small group) complete. Have each group share with the class as a whole what categories they used to sort their data. Students will present their findings to the class by sharing their large paper showing animal lists, and explaining how and why they did their charts.

Summarize: Students were able to organize categorical data as a small group, working cooperatively to create their bar charts. Students were able to articulate clear definitions of categories during their presentations.

Citations: Jonas, Ann. Splash, Harper Collins Publishers, 1995



SPLASH



Name _____

Date _____

Please cut out the characters from Splash! Arrange them on your desk in rows and compare addition and subtraction problems that go with the story.



Name _____

Animals in the Neighborhood

1. What animals did you see in your neighborhood?

2. What categories did you use to sort your data?

3. Draw a picture of your bar graph.

**4. What are three interesting things you noticed about your data?
Write them on the back of this paper.**

Name _____

Check List for making a new bar graph

_____ **I am not sure how to begin a graph of my own.**

_____ **I know how to collect data to make another graph.**

_____ **With a little help I could put my data on a graph.**

_____ **I could put my new data on a graph.**

_____ **With a little help I could collect data and make a new graph.**

_____ **I could collect data and make a new graph.**

_____ **I can explain my graph data to others.**

Grandma's Button Box – Venn diagram

Objective: Students will construct categories to describe data, and create Venn diagrams. Students will articulate clear definitions of categories, and know when and how the categories overlap at times. Students will organize and display categorical data in a Venn diagram. This lesson will take place over two or three days.

Materials: Books: Grandma's Button Box and The Great Graph Contest. Unifix cubes, buttons (approximately 50 for each small group), sticky notes and Venn diagram paper.

Launch: Present a closed button box to the children and see if they can guess what is inside the container. Shake it so it makes noise, pass the container around if appropriate. Come to a group conclusion and open the box to see if correct. Read story Grandma's Button Box to children, beginning with discussing the cover and title. Talk with the children about where could Grandma have gotten her buttons? What might she do with them? Why does she keep them in a closed container?

Explore: Read the story to the children, discussing the picture and story line as you read.

Share: Have children count the number of buttons that they have on the clothes they are wearing. They then make a bar out of Unifix cubes representing that number. Have students arrange their Unifix cubes from smallest number to largest number and discuss what this data tells us.

Launch: (2nd day) Refer back to book The Great Graph Contest, pages 14 through 17. Reread these pages and discuss Venn diagrams.

Explore: Pass out Venn diagram, buttons and pre-written sticky notes with attributes listed. Each group will be given 2 different attributes which consist of shank, 2 holes, 4 holes, large, small, various colors, various shapes such as circles and squares, metal, plastic, smooth or textured. For example a group may be given the attributes red and 2 holes. They then have to decide which part of the Venn diagram that button is placed and why.

Share: Each group will share their Venn diagram with the class, explaining their attributes and what each means.

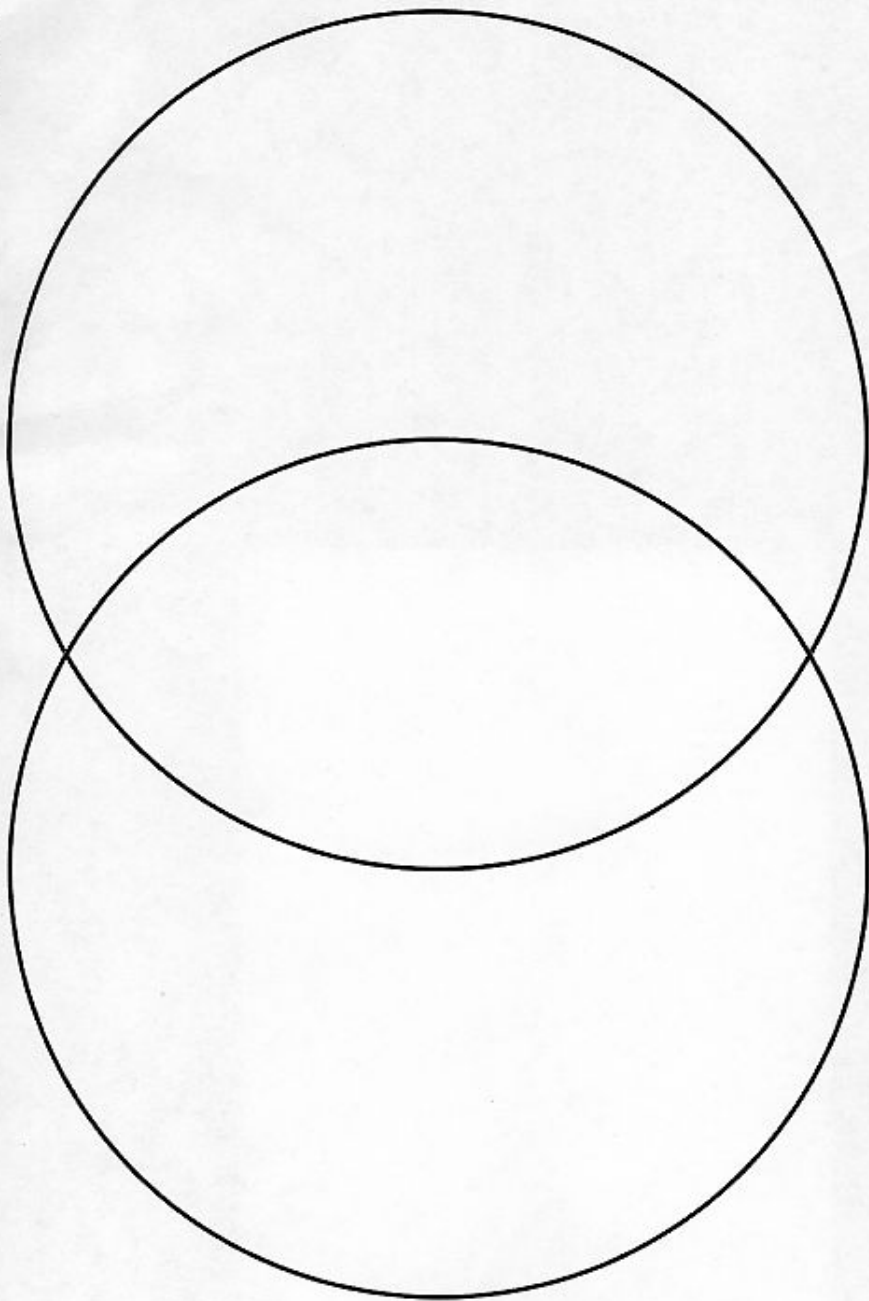
Summarize: Through observation, teacher will determine which groups were able to correctly define their attributes and know when and how the categories overlapped. They were also able to clearly explain their data results to the class.

Citation: Utah Lesson Plans, resources@uen.org
Aber, Linda W. Grandma's Button Box, The Kane Press, 2002

Name _____



Date _____



Name _____

**Draw your Venn diagram with the buttons in the correct categories.
Be sure to use labels.**

Check List for making a new Venn diagram

_____ **I am not sure how to begin a graph of my own.**

_____ **I know how to collect data to make another graph.**

_____ **With a little help I could put my data on a graph.**

_____ **I could put my new data on a graph.**

_____ **With a little help I could collect data and make a new graph.**

_____ **I could collect data and make a new graph.**

_____ **I can explain my graph data to others.**

Dirty Wow Wow and other love stories - Circle graph

Objective: Students will construct categories to describe data, and create circle graphs. Students will articulate clear definitions of categories. Students will organize and display categorical data in a circle graph. This lesson will take place over two or three days. This is also a social skill in communication and accepting other students interests.

Materials: Books: Dirty Wow Wow and other love stories, and The Great Graph Contest, a circle graph divided into as many parts as students in class, and each child needs to bring a stuffed animal from home.

Launch: Each teacher will pick out several stories from the book to share with the students.

Explore: Discussion about their favorite love objects, the importance of having a love object of your own, and how to choose which love object to school the next day. Predict how many students will bring in teddy bears, dolls, blankets, etc. Record the predictions on chalk board.

Explore: (2nd day) Discussion about similar attributes determine category placement. Decide on categories and write them on board. Each child introduces his love object and states which category it fits into, being sure class agrees with decisions. Each child gets an equal wedge of the tag-board pie chart. They draw a picture their love object on their tag-board piece. Assemble the pie chart by each child bringing up their individual piece and placing it back into the circle, being sure that same categories are grouped together. Each student will draw a picture of the graph on their worksheet, and complete the self assessment.

Share: The students will recognize groupings of categories and tally how many fall into each group. They will determine which is the most common object and which are the most unique.

Summarize: The students will be able to group data into categories, and as a class build a circle chart. They will be able to analyze and verbally interpret the chart. The students will be able to communicate with empathy and understanding as to why each object is unique. Students will be graded through teacher observation and self assessment.

Citation: Katz, Cheryl and Jeffrey. Dirty Wow Wow and other love stories, Ten Speed Press, 2007.

Name _____

Draw a representation of our class circle graph.

Check List for making a new circle graph

_____ **I am not sure how to begin a graph of my own.**

_____ **I know how to collect data to make another graph.**

_____ **With a little help I could put my data on a graph.**

_____ **I could put my new data on a graph.**

_____ **With a little help I could collect data and make a new graph.**

_____ **I could collect data and make a new graph.**

_____ **I can explain my graph data to others.**

Assessment

Assessment will include observational anecdotal records that teacher has collected throughout unit. It will also involve student's portfolios and journaling entries, as well as individual assessments following each graphing activity. For some grade levels it will include a pre and post test.

Rubric scoring for Scarecrow glyph

0. Did not follow any direction, no participation.
1. Some items present, followed a few directions.
2. Most items present, followed most of the directions.
3. Everything in place, followed all directions.

Rubric scoring for learning how to Tally

0. Did not follow any direction, no participation.
1. Understood drawing one line per object counted.
2. Understood and used slash for every 5th item counted.
3. Understands and easily uses tallying for counting objects to 100.

Rubric scoring for after each type of graph

0. Did not follow any direction, no participation.
1. Can do 1 part of activity such as collecting data, but not able to do all parts.
2. Can do most parts of activity such as collecting data, but not able to do all parts.
3. Shows some understanding, and is able to collect data, record, analyze and explain graph to others with assistance.
4. Able to collect data, record, analyze and explain graph to others

Develop Score sheet with students to score their graph representations. An example would be:

Score sheet

1 – Average 2 – Good 3 - Great

Correct Math		
Creativity		
Neatness		

Pretest/ Post test for 2nd grade students

Name _____

1. What is data?

2. Give an example of how you can collect data?

3. What is a graph?

4. What is a quantity graph?

5. What is a bar graph?

6. What is a circle graph?

7. What is a Venn diagram?

8. What are tally marks?

9. How do you determine categories?

10. Do you enjoy making graphs?

Assess Instructional Changes

1. Lesson Plans

We are using children's literature to introduce graphing skills to 1st and 2nd grade students. Refer to Table of Contents to lead you to page numbers with our lesson plans.

2. What actual changes are you making?

We are combining children's literature and hands on activities to enhance their math unit on graphing.

3. What effect should these changes have?

We expect our students to grasp the basic math skills of collecting, arranging, analyzing and comparing data. The bonus of combining children's literature and hands on activities is that the students will enjoy math activities more than previously, increase their vocabulary and see how math can be used across the curriculum.

4. Formulate hypotheses – null and alternate

We will be comparing our students pre-test and post test to see if their knowledge of data collection and constructing graphs increases. Our student to student hypothesis states:

Ho: The students will show no increase in their graphing skills.

Ha: The students will show an increase in their graphing skills.

Ho: The teachers will show no increase in graphing skills when comparing a class using children's literature, not only a math text book.

Ha: The teachers will see an increase in graphing skills when comparing a class using children's literature, not only a math text book.

5. Experimental design for collecting data

We will be comparing our students pre-test and post test to see if their knowledge of data collection and constructing graphs increases. We would compare each post test to the student's pre test scores. Our assessment will be less formal, so instead of using the t-test, we will be constructing box and whisker plots or bar graphs for each student.

During the school year we will be collecting data by a variety of ways; teacher anecdotal observations, student's self evaluations, parent teacher conferences, reviewing student's portfolios and journals, mid term grades and weekly assignments. Data will be reviewed for problems and documented. Data will be added on a weekly basis.

As the school year progresses we will try to compare the differences between teaching styles and classes. We would like to engage in discussion with other elementary faculty to see what is working or not working in their classroom as compared to ours.

6. Data is collected, reviewed for problems and documented
To be determined
7. Data analysis – statistical tools you will use to analyze your data:
 - a. Graphical tools: We will construct box and whisker plots or bar graphs to compare pre and post data.
 - b. Statistical tools: If it looks appropriate and useful we will conduct a paired t-test to look at data within our class and an unpaired t-test to look at any differences between classes.
8. Statistical results and statements of conclusions
To be determined
9. Interpretation in the appropriate context
To be determined
10. Action and dissemination
 - a. Local – students, co-teachers, administrators, parents, community
 - b. State – conferences
 - c. National – conferences and journals