## Charting the World Around Us

Summary
The students will be able to describe data represented on charts and graphs and answer simple questions related to data representations.

## Main Core Tie

Mathematics Grade 2
Strand: MEASUREMENT AND DATA (2.MD) Standard 2.MD. 10
Materials
Crayons -- red, blue, green, orange

- Football Chart (pdf)

Pencils
Student math journals

- Cups of Lemonade Sold (pdf)

Whiteboard markers

- Chart (pdf)

Document camera, optional
Digital projection camera and accompanying computer, optional
Excel program
Colored markers
Variety of crayons

- What's My Favorite Food? Data Sheet (pdf)

Black marker
Books:

- Lemonade for Sale
, by Stuart J. Murphy, ISBN: 0064467155
- Tiger Math
, by Ann Whitehead Nagda and Cindy Bickel, ISBN: 0805062483
- Banana Split and Other Snack Recipes
, by Heather E. Schwartz, ISBN: 1429613394
- Peanut Butter and Jelly Sushi and Other Party Recipes
, by Kristi Johnson, ISBN: 1429613408
- Wormy Apple Croissants and Other Halloween Recipes
, by Brekka Hervey Larrew, ISBN: 1429613386
- Oodle Doodles Tuna Noodle and Other Salad Recipes
, by Kristi Johnson, ISBN: 1429613416
- Making Graphs, I Can Do Math
, by Michelle Wagner Nechaev, ISBN:0836841115
- Graphing Activities
, by Joy Evans, ISBN: 1557991243.
- Graph Games
, by Susan Holding, ISBN: 0690349645.
- Get Up and Go!
, by Stuart Murphyl, ISBN: 0590238116
- GraphADay
, by Michelle Long Windmoeller, ISBN: 0742401460
- Graphing Primer
, by Laura Duncan Choate \& JoAnn King Okey, ISBN: 0866514864
- Dollars
, by Mary Hill, ISBN: 0516251708
Media:
- Math Concepts for Primary Grades
, by 100\% PRODUCTIONS 19982001, UIMC (Utah Instructional Math Consortium), Utah State of Education.
Organizations:
NCTM, National Council of Teachers of Mathematics


## Background for Teachers

Understanding what data and charts/graphs are, collecting data, graphing data, and making use of the information represented are difficult concepts for second graders to grasp. Research and common sense tell us a clear vision is a vital aspect of graphing data and comprehending the information on the charts/graphs. Students must be able to disentangle the many different items appearing on a graph and easily use the information. The data must stand out ( Elements of Graphing Data, by William S. Cleveland, 1994). Graphing data on a chart gives us a visual picture so we may see the information from a different perspective. The quick view of the chart can help us more easily solve a particular problem.
In Utah, second graders need to collect, organize, display and interpret numerical data in a variety of ways. Students should be able to describe the data on the charts and graphs and answer simple questions related to the data representations.
This lesson will help students understand what "data" and charts/graphs are and will use variety of ways to practice making and reading data charts/graphs. Various games will engage students in using graphs within the scope of common life activities.

## Intended Learning Outcomes

I. Demonstrate a positive learning attitude
5. Understand and use basic concepts and skills
6. Communicate clearly in oral, artistic, written, and nonverbal form.

Instructional Procedures
Content Connections:
Science Observe, record, and compare how the behaviors and reactions of living things help them meet their basic needs. Identify behaviors and reactions of living things in response to changes in the environment, including seasonal changes in temperature and precipitation.
Invitation to Learn:
Have several crayons of the following colors on a table for students: red, blue, green, orange. As students are getting ready for math, invite small groups of students to the table to color in a square on a data chart according to the following preferences. Students who like the Dallas Cowboys football team use a blue crayon to color in a square in the column labeled "Dallas Cowboys" (see Football Chart page -- if possible, enlarge the chart to poster size. After students have marked their choice, display it on a wall). Students who like the San Francisco 49ers use a red crayon on the column labeled "San Francisco 49ers." Students who like a team other than the Cowboys or 49ers use a green crayon on the column labeled "Other Teams." Students who don't know who they like, or who may not like football, use an orange crayon on the column labeled "Don't Know or Don't Like." When
all students have colored a square on the chart, ask students to think about the data on the chart. Have students write what they know about the data in their math journals. The journal entries will help serve as a preassessment to this lesson.
Instructional Procedures:
Lemonade:
This lesson will build upon information students learned in first grade about collecting and organizing data. In second grade, students will further expand their knowledge by learning how to collect a variety of data, make charts and answer questions related to the charts they make. Bring students to the rug area or other area where students can be close to the teacher and see the pictures from the book.
With these goals in mind, read the book, Lemonade for Sale. Briefly talk about the story in general.

Then ask: "What problem did the children have in the beginning of the book?" (Clubhouse was falling down and the piggybank is empty.)
Ask: "How did the children decide to solve the problem?" (Sell cups of homemade lemonade.)
Ask: "How many cups of lemonade did the children need to sell to fix the clubhouse?" (3040 cups each day for a week.)
Ask: "How did the children keep track of the cups they sold each day?" (Sheri made a bar graph.)
Ask: "How many cups did they sell the first day, Monday?" (30)
Ask: "How many cups did they sell the second day, Tuesday?" (40)
Ask: "How many cups did they sell the third day, Wednesday?" (56)
Ask: "How many cups did they sell the fourth day, Thursday?" (24)
Ask: "Why didn't the children sell very many cups of lemonade on Thursday?" (The people were down at the corner watching Jed juggle.)
Ask: "How did they solve the problem of getting those people who were watching Jed to come buy cups of lemonade at their lemonade stand?" (Sheri invited Jed to juggle lemons beside the lemonade stand.)
Ask: "How many cups of lemonade did they sell on Friday?" (So many that the sales were over the top.)
Ask: "What does 'over the top' mean in this story?" (There were so many cups of lemonade sold that they marked the bar graph to the top and over the line at the top.)
Reread the pages that show the number of cups of lemonade sold. Show pictures in the book to the students.
Make a class chart of the number of cups of lemonade sold by each day (See Cups of Lemonade Sold page -- enlarge to poster size.)
Refer to the bar charts/graphs in the book to get the correct number of cups of lemonade sold each day.
Make the connection between answers to the questions you've been asking and the definition of "data." When we collect information about a subject, such as the information the students have collected from Lemonade for Sale, that information is called data. Data can come in various forms: numbers, ideas, lists of things, etc.

Ask the students: "What 'data' is collected in Lemonade for Sale?" (Number of cups of lemonade sold each day)
Now have a class discussion about charts/graphs and why they give us good data information. Include in the discussion where charts are seen in daily life (newspapers, magazines, grocery stores, etc.). Include the fact that bar graphs can give us information at a quick glance.
Write some of the facts about the class on the white board using words and numbers, for
example: Write how many students have black hair -- "Two students have black hair." Write how many students have blonde hair -- "Seven students have blonde hair." Write how many students have brown hair -- "Nine students have brown hair." Write how many students have red hair -"Two students have red hair."
Now make a bar chart, labeled "Hair Color Chart," showing the same information (use the $\qquad$ Chart page). An option would be to use a document camera (such as an ELMO or other brand) hooked up to your computer and a digital projector for this chart so all students can view the page without having to enlarge it to poster size. Or you may scan the chart into your computer and use the digital projector to show this chart on the white board. Color in the squares, using different marker colors, as you model how to make the chart. Do not write on your canvas rolldown screen.
Through discussion with the students, help them to discover the bar chart is an easy way to "see" information, and the bar chart is an easy way to get information quickly. Using another $\qquad$ Chart page, labeling it "Shirt Colors Chart." Ask students to decide what the main color of the shirt they are wearing today. An easy way to help students is to have all the students with blue shirts group together in a corner of the room; all students with green shirts stand in a different corner of the room, etc.
Have students work in groups to make a bar chart of the color of the shirts (or some other similar item) by counting the number of students in their group. Use various colors of crayons for the different columns.
In the back of Lemonade for Sale, author Stuart J. Murphy gives some good ideas for further study of graphs.
Use some of the ideas Mr. Murphy suggests to help children count various objects and make bar graphs and paste them in their math journals.
Growing Tigers:
Review briefly what a bar chart/graph looks like and how it gives us information at a quick glance. Bring students to the rug area or other area where students can be close to the teacher and see the pictures from the book.
Instead of having students at the rug, an option would be to use a document camera hooked up to your digital projector. This set up would make the pictures and graphs in the book large enough on the screen for all students to see equally well.
Preread the book, Tiger Math. Keeping in mind the information written on the left pages, read the story (the rightside pages) about T.J., a Siberian tiger cub born at the Denver Zoo. Briefly discuss the story with the children, helping them to know this is a real story about a real tiger. Now go back to the various graphs in the tiger book and discuss how they are different from the bar graphs students used in the previous activity. Bring out the following points, as well as any others points students may find:

Pictures are sometimes used to show "how many" in charts or graphs. This time it shows how many tigers there are in the wild.
circle chart is different in shape and uses various colors to show the different data.
Small squares can represent individual numbers on a chart.
Charts can have backgrounds, but that doesn't change the data represented on the chart -it gives character or makes the chart fun.
A chart can have two or more things (this time it's tigers) represented on the same graph, comparing the two or more things -- see the bar charts and line charts in the book.
A line graph is another way to show data.
Use various questions to compare the charts. Ask what the students can discover about the tigers' growth, what they ate, and how they compared to each other.
Look at the chart on page 8. Ask: "How many Sumatran Tigers live in the wild? Help students to
understand that each tiger picture represents 500 tigers in the wild." (500)
Ask: "Which kind of tiger has the most living in the wild?" (Bengal Tiger)
Ask: "Which kind of tiger has 1,500 tigers living in the wild?" (IndoChinese Tiger)
Look at the chart on page 10. Ask: "According to this pie chart, which kind of tiger has the fewest living in the wild?" (South China)
Ask: "Which kind of tiger has the most living in the wild?" (Bengal)
Look at the chart on page 16. Ask: "How much more did Matthew weigh at 6 weeks than T.J. weighed at 6 weeks?" (4 pounds) Show students that the "numbers" on the chart represent pounds.
Ask the students to give an example of "data" from this book, i.e. the number of tigers in the wild, T.J.'s weight in pounds, Matthew's weight in pounds. Ask the students why they think this information is important.
Have a discussion as to the importance of the data, the information the Denver zookeepers, and why they wrote the book.
Favorite Food
Preview the following books: Banana Split and Other Snack Recipes, Peanut Butter and Jelly Sushi and Other Party Recipes, Wormy Apple Croissants and Other Halloween Recipes, Oodle Doodles Tuna Noodle and Other Salad Recipes. Let the students know the goals of this lesson are to (1) collect data from these recipe books (the data will be in form of their favorite foods); (2) chart that data on large charts; (3) discuss what information they can "see" from the chart. Also, prepare for this lesson by making four postersize charts of the chart, $\qquad$ Chart. Looking ahead, a fun followup activity would be for the students to make one of the class favorite snacks, preferably with the help of a class mom.
Start the lesson by dividing the class into four groups. Give each group one of the recipe books and each student a data sheet -- What's My Favorite Food?
Direct the groups to look through their books, reading the recipes and looking at the pictures. Each student should choose a recipe he/she likes the most. As students pick their favorite recipe, they should fill out the corresponding book line on the top part of the What's My Favorite Food data sheet.
Rotate the books through all groups using the same process of choosing favorite foods and having students record their data on the top of the data sheet.
The next few steps of the lesson can be confusing for students, so proceed accordingly. Ask each group to choose a scribe. You may want to use yarn and make a cardstock "Scribe" sign for each scribe to wear over his/her neck. Explain the duties of the scribe -- the person will write what the group chooses. The scribe will use the bottom part of his/her data sheet, labeled "Group Favorites," to record information.
Now have the students take turns telling the scribe in their group their favorite food recipe from Banana Split.
The scribe will record the data in the appropriate box on the bottom portion of his/her data sheet. To assess student understanding of charting data, walk around and monitor groups.
After the scribes have written groups' choices for all four of the books, prepare for the next step by bringing students to the rug, asking scribes to bring their data sheets. No one else need bring their data sheets to the rug.
Have the poster size $\qquad$ Chart taped to a board low enough students may reach it. Fill in the
$\qquad$ with "Banana Split." The names, or a shortened version, of the ten recipes should be written on the bottom of the chart (black marker), each one under a column.
Ask the scribes, one at a time, to slowly give the names of the favorite recipes to the class. A student from that group should go mark a box on the postersize chart to represent the data from Banana Split. Use different colors of markers for each recipe.

Make the connection that you are using data from the students' data sheets to make a chart/graph.
After the chart is completed with the class data represented, ask probing questions, like the following. Not all questions will be relevant to each chart.

Is there a recipe that stands out as having lots more boxes filled in compared to the other recipes?
Which recipe has the most? The least?
How many more or less did one choice have vs. another?
Are there any recipes that have the same number or very close to the same number?
What does that tell you, if they are the same or close to the same?
Is there a class favorite?
Is the class favorite an easy recipe to make?
What else does this data chart tell you about the recipes in Banana Split?
The questions and discussions centered on the charts are the very basis of understanding data, charts, and graphs. This understanding will help students make the connection of data to charts and graphs and further more, to using the information as students make educated decisions in daily living.
For more practice, students should make a separate chart/graph for each of the recipe books. IMPORTANT: To make the connection and comprehension of charts and graphs complete, help students understand different types of charts and graphs by transferring the Banana Split data to a prepared Excel file. If possible, show the data on a digital projector so all students can watch you enter the data. Create a chart from the entered data. Show the chart in the various forms -bar, pie, line, scatter, tally, pictograph, etc. Discuss the differences of the charts. Give some examples of when you would use the different charts. Keep it simple.
Refer to the Extension Activities for lots of data, charts, and graphs practice.
Refer to the various websites, including previous years' Core Academy lessons, for more practice.
Core Academy 2004, Second Grade, Where Do I Fit on the Graph? This lesson is especially good for charts and graphs.
Lesson and Activity Time Schedule:
Each lesson is 55 minutes.
Each activity is 30 minutes.
Total lesson and activity time is 90 minutes.
Activity Connected to Lesson:
Land, Air, or Water
Read the book, Quick as a Cricket, to the students. Have the students decide whether the animals in this book live on the land, in the air, or in/around water. Have students collect the data and make a tally chart. Have students discuss the information from the chart. How does a tally chart differ from a bar chart? Where else can tallies be used? Give some examples where tally charts work well (counting people in a room, counting students going to lunch, counting votes in a school election, etc.). The book, Animal Snackers, is a good one to work with struggling students.
What's for Lunch?
Read the book, The Cafeteria Lady from the Black Lagoon. Have a discussion about favorite school lunch foods. (Remember that some students may never eat school lunch.) Graph students' favorite foods. Use a bar chart. Now make a different kind of chart/graph using the same data. Discuss the differences between the two charts. Now make a third chart using the same data. Again, discuss the differences between the three charts. Have students write three facts about the charts in their math journals.
Chart Museum

Read the book, The Great Graph Contest. There are a variety of data collected and charts made in this book. Now, reread the book and after each kind of chart in the book, have a discussion about how the characters made their graphs and why they used that particular chart/graph each time. Have a discussion about the charts and have students write in their math journals about the various graphs. Make a home assignment for students to make a creative graph at home with something of their choosing. Have them bring the chart to school and have a Chart Museum where students will walk around looking at the various charts. Students should write two numerical facts about every chart/graph in their math journals.
Group Reporting
For high ability students, have them do a group read of the book, Graphs. Have them discuss the creative ways Gary (main character from the book) found to collect data and make charts. How did he use the information? Was it useful information? How did he include others in his activities? Have the students figure out something at school about which they can collect data. Have the group create a plan to report to the rest of the class the data they collected, the chart(s) they made, and the valuable information they discovered from their project. Before the students proceed with their activity, they should make a proposal to the teacher. Challenge the group to use a chart(s) other than a bar chart(s). Or challenge them to make several different kinds of charts of the same information, explaining the differences and value of each chart. Give this group a couple days to complete this task. Make sure they include title, labels, and graphed data. Finally, have the group report to the whole class, including charts and graphs and other pertinent visual aids.
Activity Materials:
Pencils
Student math journals
Whiteboard markers
Various blank charts or paper to make charts
Colored markers
Books:

- Quick as a Cricket
, by Audrey Wood, Illustrated by Don Wood, ISBN: 0859531511
- Animal Snackers
, by Betsy Lewin, ISBN: 0805067485
- The Cafeteria Lady from the Black Lagoon
, by Mike Thaler, Pictures by Jared Lee, ISBN: 0590504932
- The Great Graph Contest
, by Loreen Leedy, ISBN: 0823420299.
- Graphs
, by Bonnie Bader, Illustrated by Mernie Gallagher Cole, ISBN: 0448428962


## Extensions

For visual and tactile learners, have students bring cutout charts/graphs from newspapers, magazines, etc. and put up on a bulletin board labeled "Charts and Graphs."
For English Language Learners, have students use pictures of items instead of word headings for charts.
Use a variety of manipulatives to make charts, i.e. linking cubes, attribute blocks, counting figures (bears, food items, etc.), doublesided counters, etc.
For advanced learners, have students create story problems using their charts and graphs. Each student should write 23 problems and exchange papers, solving the problems using the data charts.

For science, students can plant seeds of various kinds and observe their growth patterns by charting the amounts of water needed, the length of growth in a week, the kinds of leaves, etc. For science, students can track and chart daily temperature for a week, the temperatures in a single day, petals on various flowers, etc.

- Movement/P.E. activity
: Go to the gym or outside for this activity. Divide the students into groups of two or three. Each student secretly chooses an animal to imitate. Students will take turns acting out the animal. Rules can include animal sounds, or not include sounds. After all students have had a chance to imitate an animal, have students make a human chart by sorting themselves by birds, water animals, or land animals. The human chart can be made by making rows of students designated by the three categories. Now, have student repeat the activity by choosing a different partner and a different animal according to the three categories.
The Illuminations website from NCTM (listed under Web Sites) has six really great lessons on data, charts, and graphs, complete with student activity pages.
Family Connections:
Assignments to do with parents:
Ask family members to help students find graphs and charts in the newspaper, magazines, Internet, etc. Bring the cut out or copies of charts/graphs to school and hang on bulletin board labeled "Charts and Graphs."
Send home a variety of blank charts with instructions for students to collect data from a variety of options. They should create charts/graphs from the data and then write three facts about each chart. Ideas for data: top five most common grocery list items, foods for dinner, favorite family pizza toppings, kinds of shoes owned by family members (dress shoes, tennis shoes, slippers, flipflops, boots, etc.), the number different kinds of tools in the tool box, number of buttons on family coats, number of lights in each room, how many books each family member read in the last month, kind of trash thrown away, the number of peas or beans or other vegetables on each family member's dinner plate, number of pieces of mail received for each day of a week, etc.


## Assessment Plan

Students need a lot of practice using data, graphs, and charts so they will become familiar with the valuable information.
Students can complete a chart/graph with title, labels, and collected data. Students should answer comprehension questions. The UTIPS website is a great place to get sample questions. Using graph paper, have students write their whole names and graph the letters; include title, labels, and graphed data. Have students write three facts about their graph. Other ideas to graph: number of buttons on each student's clothes that day, number of pencils in each child's desk, number of baby teeth each student has lost.

## Bibliography

The Arithmetic Teacher
, Sharon L. Young, April, 1991, pp. 2833.
The Arithmetic Teacher, Jean M. Shaw and John Firkins, September, 1993, pp. 2740.

## Authors <br> VERNEITA HUNT

