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Probability and Statistics for Third through the Fifth Grade Classrooms

A thesis

presented to

the faculty of the Department of Mathematics

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Master of Science in Mathematical Science

by

Melissa Dawn McKinnon

August 2007

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Keywords: Virginia Standards of Learning, Probability, Manipulative, Cooperative Learning,
Organization, Illustration, Statistics, Graphing

ABSTRACT

Probability and Statistics for Third through Fifth Grade Classrooms

by

Melissa Dawn McKinnon

This document contains a variety of lesson plans that can be readily used by a teacher of intermediate students. This thesis contains two units in Probability and one unit in Statistics. Any educator can supplement this document with any curriculum to teach lessons from vocabulary to concept.

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DEDICATION

This thesis is dedicated to the many people who have supported me throughout my educational journey. To my family, Mark, Levi, and Jordann McKinnon, your constant love, support, encouragement, and faith has driven me to finish this journey. To my mother, your encouragement allowed my success as a wife, teacher, mother, and person. To the many friends whom I have made along the way, I will never forget our cohort. To one special friend who inspired me to become a teacher, Jaime Davis, thank you so much, you truly are special to me. Most importantly, I would like to thank my Lord Jesus Christ for being at my side, for being my strength, and for showing me the way.

ACKNOWLEDGEMENTS

The support and encouragement of Dr. Price and Dr. Seier as well as that of my colleagues at Marion Intermediate School was of great importance to me.

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INTRODUCTION

1.1 The Idea

Students in the elementary grades have a natural curiosity about their world, which leads them to the question about how things fit together or connect. They develop a need to organize things by sorting and counting according to similarities and differences.

Since high school, the author has developed a love for probability and statistics. During the author's undergraduate work, she was fascinated with using statistics in the real world. After graduation, it was decided that she wanted to investigate the possibility of higher level courses in math. During the author's first year of teaching, she spent countless hours trying to develop lessons that would engage students' interest in learning math. She then pursued her graduate work at ETSU where the idea developed to create a thesis for the author and her colleagues to use to teach third through fifth grade probability and statistics.

1.2 Available Options

The author first made the decision to restrict this thesis to third grade standards of learning in probability and statistics. But, after asking colleagues if there were a need for developing modules to teach probability and statistics, she decided to include fourth and fifth grade standards in the thesis. Teachers stated that most lessons were not in one resource book and it was difficult to find lesson plans or ideas that had a variety of activities. The author's goal is to develop staff workshops in the hope of lessening the extra time spent on searching for various grade appropriate activities in probability and statistics.

1.3 Selecting the Units

The response from other teachers led to the development of a probability unit for third, fourth, and fifth grade levels and a statistics unit for the third and fourth grade levels. The units

were designed to build concepts and develop a continuous investigation of data-collection strategies. In all, five units of study were introduced.

Each unit has vocabulary terms that the students are expected to know for each subject. A list of materials was developed for each project. The section “Model Examples” gives the teacher examples to show the students. An “In-Class Activity” section has been included for students to try alone or in a group, as well as a “Class-work Assignment”. Finally, “Homework Exercises” are provided for the teacher with an “answer key.” A sample assessment was included for each grade level to evaluate the progress of each student.

2 PROBABILITY UNIT FOR THIRD/FOURTH GRADE

2.1 Introduction

Probability is the chance of an event occurring. The focus of probability instruction at this level is to help students begin to develop an understanding of the concept of chance. A spirit of investigation and experimentation should permeate probability instruction, where students are actively engaged in explorations and have opportunities to use manipulatives. At the intermediate level, students will use manipulatives through informal activities using two colored counters, spinners, dice, coins, food, and random number cubes. The student will also begin to understand that the probability of an event occurring is the ratio of desired outcomes to the total number of possible outcomes. If all the outcomes of an event are equally likely to occur, the probability of the event equals the number of favorable outcomes over the total number of possible outcomes [6].

The student will begin to understand that the probability of an event occurring is represented by a ratio between 0 and 1. An event is “impossible” if it has a probability of 0. For example, the probability of rolling a 0 from a standard 6-sided die is 0. An event is “certain” if it has a probability of 1 that means the probability that the sun will rise tomorrow morning is 1. The student shall have opportunities to describe in formal terms (impossible, likely, equally likely, unlikely and certain) the degree of likelihood of an event occurring [6].

2.2 Standards of Learning

In the state of Virginia, a teacher receives a curriculum framework that outlines instruction for each standard. The objective for third grade probability is the following; the student will investigate and describe the concept of probability as chance and list possible results of a given situation [6].

2.3 Essential Knowledge/Skills and Understanding

All students should understand and apply basic concepts of probability. All students shall understand that probability is the chance of an event happening. The students will use problem solving, mathematical communication, and representations to:

- *Define probability as the chance that an event will occur.
- *List all possible outcomes for a given situation. (e.g. heads and tails are the two most common possibilities of flipping a coin).
- *Identify the possible outcomes for a common event, using terms such as impossible, unlikely, equally likely, likely, and certain [6].

2.4 Key Terms

To introduce key vocabulary terms, the student will use manila paper divided into sections:

- a. Probability- a chance of an event occurring.
- b. Impossible- not capable of occurring or being accomplished.
- c. Unlikely- not likely to occur.
- d. Equally Likely- an equal chance of an event occurring or not occurring.
- e. Likely- probable.
- f. Certain- definitely will occur.

2.5 Module 1 Three-Sectioned Word Game [8]

A. Materials Needed

Manila paper

Words

Definitions

Time allotment: 30-45 minutes

Overview: To begin the unit, introduce key terms with a three-sectioned organizer. The student will use manila paper and develop a list of terms with definitions. For example, list terms on the front section of the organizer and the definitions will follow on the second section of the organizer as illustrated in Figure 1. The student will proceed with this process until all words are completed.

word	def.	

Figure 1 Organizer-Three-Section

The following steps will prepare the paper for the “Three-Sectioned Word Game.”

1. Hold the paper vertically.
2. Fold it in half vertically.
3. Fold each edge again to the crease made from the half fold.
4. Fold in thirds horizontally.
5. Open thirds back to the beginning position and cut each outside piece leaving

the bottom two cuts on each side, making six flaps that open.

2.6 Module 2 Bulletin Board

A. Materials

Yarn

6 labels with key terms (one term written on each)

Paper

Crayons

Calculator

Tape

Index cards

Time allotment: 60 minutes

B. Model Example

The goal is for each student to understand the meaning of chances or the likelihood of events. The teacher will need to cut lengths of yarn to divide a bulletin board into five sections. The teacher will then review the meaning of each key term: impossible, likely, unlikely, equally likely, and certain. The teacher will then label the bulletin board with each term in one section and draw a picture of a fish in a fishbowl on the bulletin board. The teacher will begin by demonstrating an example by writing “My fish will bark” on calculator tape. He or she will then ask the students to identify which heading the sentence might go under. The teacher will respond by putting his or her example under the correct heading, impossible. The teacher will ask the students to write each word from the categories onto index cards (one word per card). He or she will then write the five sentences on calculator tape (one per strip).

(certain) 1. The sun will rise tomorrow.

(likely) 2. A student may get a drink of water.

(unlikely) 3. A student will not need to use the restroom in a school day.

(impossible) 4. A dog will talk.

(equally likely) 5. A flipped coin will land on heads or tails.

The teacher will read aloud one sentence at a time and ask the students under which category the sentence belongs. The students will respond promptly by holding up their signal card that was created earlier in the lesson. The calculator strip will then be stapled under its correct label.

C. In-Class Assignment

From a small cup, each student will choose a slip of paper with a related event on it and then illustrate that event on paper. When the students are finished, share time will begin and

each student will hang his or her display on the bulletin board. The teacher will then prompt the students for examples of terms that did not have an illustration.

D. Homework Assignment

Using the students' organizers, they will write the word on section one then the definition on section two. When finished, he or she will write a sentence to clarify the meaning on the third section. The student will illustrate each word on the back for extra credit.

Def.	sent.	

Figure 2 Organizer-Three-Section

2.7 Module 3 Pass the Ball

A. Materials Needed

Index Cards
Typed Key Terms (Appendix A)
Typed Definitions (Appendix B)
Laminating (optional)
Music (CD or Tape)
Nerf Ball
Marker
Plastic baggie
Time allotment: 60 minutes

B. Model Example

All students shall have the opportunity to describe probability in informal terms. The teacher will need to prepare index cards ahead of time. Attach one key term (Appendix A) to the front of an index card with the matching definition (Appendix B) to the back. (Laminate) The teacher will begin to explain how to play "Pass the Ball" or "Pass the Marker." Students pass the ball until the music stops, when the music stops whoever has the ball answers the

definition on the index card in the teacher's hand. This game continues until everyone has had a turn catching the ball.

C. In-Class Assignment

Each student receives index cards, key terms, and definitions. The student will cut and paste terms on the front with the correct definitions on the back.

D. Homework Assignment

Students take home index cards in a plastic baggie to study for a quiz on key terms and the definitions.

E. Quiz (Third Grade/Fourth Grade) Appendixes C and D

2.8 Module 4 Index Spinners

A. Materials Needed

Reproducible Spinners (Appendix E)

Index Cards

Plastic Bags

Laminating Sheets

A Marker

Time allotment: 2 days

Overview: All students should have opportunities to describe probability.

B. Model Example

The teacher shall have different reproducible spinners cut out and pasted onto one side of the index card. The teacher shall have numbers or color words on the cards.

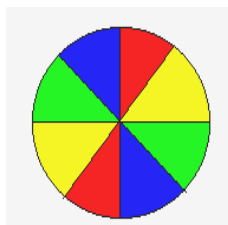


Figure 3: Spinner-Eight Section

The teacher can develop questions (Appendix F) to go with each spinner. Model Question: Look at this spinner, what is the probability of getting the color yellow? (Answer: 2 out of 8 or 1 out of 4.) The teacher can play “pass the marker” using laminated index cards.

C. In-Class Assignment

Students will focus on reviewing probability using the cards made by the teacher. The teacher will explain to the students how to make their own index cards to study the questions in order to review the concepts. The students will cut the ten spinners from the handout (Appendix E), paste one per index card, and match the correct question to go with the correct spinner. Students may choose a partner and take turns asking questions to review.

D. Homework – Study for Quiz

2.9 Module 5 Heads or Tails

A. Materials

Coins (real or play)

Paper

Time allotment: 30-45 minutes

Overview: Introducing the unit of probability should focus on identifying the key terms first. Students should be familiar with the terms in order to understand the lessons throughout the unit.

B. Model Example

The teacher can begin modeling an example using a coin to demonstrate that a coin has two sides, “heads or tails.” If the coin is fair, then it is equally likely a flipped coin will either land on heads or it will land on tails. The teacher shall begin to explain that flipping the coin many times, one would expect to produce a ratio of $\frac{1}{2}$ for heads. The teacher can review the

definition of equally likely and the student can give an example of the true meaning. The teacher can ask a student to come up and demonstrate flipping a coin.

C. In-Class Assignment

The student will write heads and tails on the chalkboard. The teacher will ask the student to flip the coin ten times. Each time, the student shall put a tally mark beside the outcome. The teacher will begin to explain the event. (By showing an example, say that the student flipped seven heads and three tails). The teacher will explain by engaging students in questions such as:

1. How many times did the student flip the coin?
2. How many times did the coin land on heads?

On the board, the teacher will show the students that the estimated probability of flipping a coin and landing on heads is seven out of ten. The teacher shall continue this random experiment and keep track of the number of heads and the number of tosses. After ten tosses, the teacher shall ask the students the outcome of their experiment. The teacher will demonstrate that to write probability in a formal format looks the same as writing a fraction. The bar or line between the number of favorable outcomes and the total number of possible outcomes is called a fraction bar. So, the teacher will identify the answer as: there are two possible outcomes when flipping a coin, the coin was flipped ten times, it landed on heads seven out of those ten times. Therefore, the estimated probability is seven out of ten ($7/10$).

The teacher shall prompt the students to repeat the experiment with twenty trials.

D. Class-work Assignments

The teacher will give each student a coin. On the scrap paper, the student will write heads or tails. He or she will begin to use the coin for experimental probability. When finished, each student will tally his or her outcomes on paper.

E. Homework Exercises

In a math notebook, the student will write heads on one side and tails on the other.

With a guardian:

1. Flip the coin 10 times and record student data.
2. Guardian will flip the coin 10 times and record the data.
3. Compare probability.

2.10 Module 6 Flip a Coin for Goods and Services

A. Materials

(2) Standard sized green construction paper

(3) 1" x 12" black construction paper

1 coin

1 white crayon

Time allotment: 2 days

B. Model Example

The student will list all possible outcomes for a given situation. Heads and tails are the two common outcomes when tossing a coin. The teacher will explain that this activity can show an equally likely event by flipping a coin. This activity will also incorporate some economics (goods and services). All students shall paste their green construction paper together making sure the paper is horizontal on the desk. The student shall measure about one inch from the top left side of the paper and one inch from the bottom left side of the paper and paste a piece of black construction paper vertically, see illustration in Figure 4.

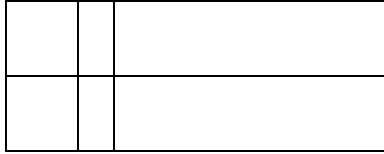


Figure 4: Picture 1 Goods & Services

Students will take another black piece of construction paper and cut in half. One sheet will then be pasted about three inches from the top and the other black strip will be pasted at the bottom as in Figure 5.

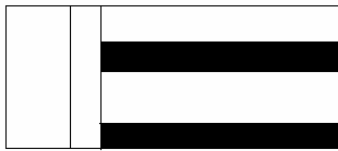


Figure 5 Picture 2 Goods & Services

With a white crayon, students will write their (last name) on the strip labeled in Figure 4 with the word lane following, (e.g., Smith Lane). From Figure 5, the student will write Goods Road, and continue with Service Street from Figure 6. The student will draw a compass rose in the corner and label the compass with the correct cardinal directions.

C. In-Class Assignment

Students will draw some type of business on their Goods Road and Service Streets. When the activity is completed, the students will develop a game by tossing a coin using the following directions. If a (H) is flipped, go West onto Goods Road; if a (T) is flipped, go north onto Service Street, then the students can see the business or shop they landed on.

D. Homework Assignment

The student will come up with his or her own directions for landing on the specific lanes, streets, and roads, then the student will toss the coin 10 times and record the data.

2.11 Module 7 Lunch Bag Probability

A. Materials

The materials listed can be used for the entire unit of probability. Two color counters, number cubes, dice, coins, colored erasers, two colored checkers, chess figures, colored marshmallows, M&Ms, skittles, valentine candy hearts, fruit loops, apple jacks, gummy bears, colored balls, various pet and animal pictures(for example: sharks, fish, starfish, jellyfish, dogs, cats, birds, squirrels), paper numbers (0-6), marbles, poker chips, cards, and coins. The student will also use crayons, scissors, pencils, lunch bags, and scrap paper.

Time allotment: varied

B. Model Example

The teacher will decide on what manipulative he or she will put in the lunch bag. This unit can be used for two or three days and be exchanged for a different manipulative in the bag. The student will count while the teacher is placing the item into the bag. For accuracy, the teacher will recount the manipulative in the bag. The teacher will demonstrate by pulling one coin from the lunch bag and placing a tally mark on notebook paper to represent the number of outcomes in this experiment. The teacher will remind the students that their final answer will look like a fraction; the numerator is the number of favorable outcomes and the denominator is the total possible outcomes.

C. In-Class Assignment

The students work with partners, taking turns pulling coins from a lunch bag, and recording the outcomes on a piece of notebook paper. They will continue this assignment for three rounds to collect information for their experiment.

D. Homework Assignment

Students will use two different kinds of cereal at home, place a handful of each into a lunch bag, draw 10 times, and record the probability.

2.12 Module 8 Roll a Die [4]

A. Materials

Graph paper transparency

1 die

1 overhead projector

1 overhead pen

Writing paper

Plastic berry basket (optional)

Materials for the students

1 die

1 sheet of graph paper

Crayons

Markers or colored pencils

Plastic berry basket (optional)

Time allotment: 1 – 2 days

Overview: Dice are found in various forms and in many parts of the world; they have also been used in both modern and ancient games of chance. In this activity, students use standard dice cubes with dots representing the numbers one through six. Pairs of students will roll dice to generate data, then discuss and analyze the results. This experience will lay the foundation for future explorations of probability.

B. Model Example

Invite students to share what they know about dice. Ask them, “What games can be played using dice, and why do you think dice are used?” Tell students that the dice will be used for more investigations into probability. When a standard die is rolled, what are the possible

outcomes? Ask, “Will one number come up much more frequently or will there be an equally likely chance of tossing each number?”

The teacher will ask students to make a prediction on how many times will each number appear if the die is tossed 30 rolls. The students will explain their predictions to the teacher. The teacher may include, “Do all 6 numbers have the same chance? Would you say that your prediction is more like a wild guess or an educated guess?”

The teacher will put a transparency (blank or graph paper transparency) for the data sheet on the overhead and then have the students make their data sheets. A volunteer will roll a die 30 times while the teacher records the results on the overhead projector. The teacher shall stop several times during the data collection to allow time for the students to analyze the data. The teacher will ask for “true statements” about the data and ask the student to predict the results for the entire class. If necessary, remind students to record the data accurately, even if their favorite number is losing.

C. Classwork Assignment

The teacher will distribute graph paper or blank paper to each pair of students, allowing time for them to make their own data sheet as needed. Students shall make a prediction on how many times they think each number will be rolled. The teacher shall remind students to use tally marks to keep track of their rolls. A volunteer will distribute one die to each pair of students. The teacher will have the students roll the die 50 times and chart their data. The teacher will then have a few students report their data and observations to the class. Questions can be asked such as, “What happened? Were the predictions close to the end results? What was surprising about the “Roll the Die” investigation?” The students will share their predictions with another group. The teacher shall encourage discussion about the experiment and save

student data sheets for the graphing session. When each group is finished, the teacher will take the final count of coin tosses and find the average of the entire class.

D. Homework (Choose One)

1. Using a new sheet of graph paper, conduct the same experiment except decrease the number of rolls to 30 times and compare the two experiments.
2. Write a letter to a company that makes dice and explain an idea for a new kind where the number six comes up more often than any other number. Students can illustrate their letter.

2.13 Module 9 Learning About Ratios A Sandwich Study [7]

A. Materials

Chalk
Peanut butter
Jelly (one container per group)
Measuring spoons
Cups
Plastic knives
Teacher developed graphs
Pencils
Paper for students
Paper towels
Damp sponge
Time allotment: 1 day

Overview: Ratios can be a difficult idea for elementary students to grasp. They need to spend time manipulating “real” objects providing a tangible reference to deal with a concept in a practical fashion.

B. Model Example

Prior to class, the teacher will write in large letters on the board RATIO in the center of the board. He or she will begin to introduce ratio by giving the correct definition making sure the students have a clear understanding and how the word compares to a fraction. The teacher will select 10 students to come forward and be divided into groups of six. The students can

collaborate and develop a name for their group. The teacher will write the word boy and girl on the board. A volunteer will count the number of boys and the number of girls and give the results. The teacher will display the number of boys and girls in ratio form on the board.. (For example, 8:10.) He or she will explain that this expression identifies the ratio of boys to girls in front of the classroom. The teacher will use two additional examples (students who use colored pencils to those who use twisted crayons) and label the answers on poster board. He or she will return to the term on the board and the students will make a comment. The students will identify the definition of ratio and the teacher will continue to guide the students in having a define understanding of ratio.

C. Classwork Assignment

The teacher will divide the class into groups of six and direct each group to make a series of six peanut butter and jelly sandwiches, each containing a different ratio of the given spreads. Students are to label each ratio, being sure to label the amount of peanut butter and jelly that was applied to each sandwich and then cut each sandwich into pieces. A sample graph would look like this:

Peanut Butter	Jelly	Rating
5T	0T	1 2 3 4 5 6
4T	1T	1 2 3 4 5 6
3T	2T	1 2 3 4 5 6
2T	3T	1 2 3 4 5 6
1T	4T	1 2 3 4 5 6
0T	5T	1 2 3 4 5 6

The students will conduct a taste test of the preferred ratio and rate it on a scale of one to six. Each group will share their charts with the rest of the class and compare them.

D. Homework Assignment

1. Conduct a ratio study similar to the one used in class with peanut butter and jelly.
2. Choose red and white paint to create the most desirable shade of pink.
3. Write at least one page on the discovery from the experiment. Students shall prepare a presentation to share in class.

Modified from [7]

2.14 Module 10 Getting Dressed [5]

A. Materials

Shorts and shirts activity sheet via internet website

Crayons

Time allotment: 1 day

Overview: In grades 3-5, students are encouraged to discover all the possibilities and combinations for a given situation. Students apply problem-solving skills to draw conclusions.

B. Model Example

Discuss with the students that when getting up in the morning it is sometimes a difficult task to decide what to wear. For example, our choices might be two pair of jeans, three pair of shorts, two shirts, and two hats. The clothes can be mixed and matched to get different outfits and the objective of the lesson is to find out how many different combinations are available to wear. A volunteer will distribute the “shorts and shirts” activity sheet to each student. Students will color outfits to determine the total number of combinations possible.

C. Classwork Assignment

The teacher will give each student eight crayons: red, green, yellow, blue, orange, black, brown, and purple. The teacher will review the problem by reading it with the students: Each shirt must be a solid color; yellow, orange, blue, or red. Each pair of shorts must be a solid color; brown, black, green, or purple. The teacher might ask, “How many different outfits can be made?” and remind the students that no two outfits can be the same.

The teacher will guide the students to predict how many different outfit combinations can be put together. He or she shall record the predictions on the activity sheet allowing enough time for students to color their combinations. Place students in partners to compare their results.

As a class, discuss the results. The teacher may also take the students to the computer lab to visit the web site: <http://illuminations.nctm.org>.

The student will click on the Bobbie Bear applet and choose an outfit for Bobbie Bear. Then customize the outfit similar to the one on the activity sheet.

D. Homework Assignment

The students will go home and look at their short and shirt wardrobe. They will write down three different pair of shorts and four different colored shirts on a sheet of paper. The students will combine shorts and shirts to see how many different outfit combinations can be made.

3 STATISTICS UNIT FOR THIRD AND FOURTH GRADE

3.1 Introduction

The focus of statistics instruction at this level is to help students develop methods of collecting, organizing, describing, displaying, and interpreting data to answer questions they have posed about themselves and their world. The statistics instruction is to assist students with further development and investigation of data-collecting strategies. Students should continue focusing on question formation, collecting data and organizing these data into meaningful graphs, charts, and diagrams based on issues relating to real-world experiences. Students should interpret data presented by these graphs, answer descriptive questions (e.g., “How many?”, “How much?”) from the data displays, and identify and justify comparisons (e.g., “Which is the most?”, “Which is the least?” “Which is the same?” “Which is different?”) about the information. Students should compare their initial predictions to the actual results and write a few sentences to communicate to others about their analysis and interpretation of the data [6].

3.2 Standards of Learning

The student, given grid paper, will collect and organize data on a given topic of his or her choice, using observations, measurements, surveys, or experiments and construct a line plot, a picture graph, or a bar graph to represent the results. Each graph will include an appropriate title and key [6]. The student will read and interpret data represented in line plots, bar graphs, and picture graphs and write a sentence analyzing the data [6]. The student will collect, organize, and display data in line and bar graphs with scale increments of one or greater than one and use the display to interpret the results, draw conclusions, and make predictions [6].

3.3 Essential Knowledge and Skills [6]

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to:

1. Formulate questions to “investigate.”
2. Design data investigations to answer formulated questions limiting the number of categories for data collection to four.
3. Collect data using surveys, polls, questionnaires, scientific experiments, and observations.
4. Organize data and construct a bar graph on grid paper representing 16 or fewer data points for no more than four categories.
5. Label bar graphs with a title, a description of each axis, and a key where appropriate, limiting intervals on the numerical axis to whole numbers representing multiples of one, two, five, or ten.
6. Read the information presented on a simple bar or picture graph (e.g., the title, the categories, the description of the each axis, and the key).
7. Read information presented in line plots.
8. Analyze and interpret information from simple picture and bar graphs, with data points limited to sixteen, categories limited to four, and write at least one statement.
9. Analyze and interpret information from line plots, with data points limited to sixteen and write at least one statement.
10. Describe the categories of data and data as a whole (e.g., data were collected on four types of eggs-scrambled, fried, hard-boiled, and egg salad- eaten by students).

11. Identify parts of the data that have special characteristics including categories with the greatest, the least or the same (e.g., most students prefer scrambled eggs).

12. Select a correct interpretation of a graph from a set of interpretations of the graph, where one is correct and the remaining three are incorrect. For example: a bar graph containing data on four types of eggs- scrambled, fried, hard boiled, and egg salad- eaten by students show that more students prefer scrambled eggs. A correct answer response, if given, would be that more students prefer scrambled eggs than any other type of eggs.

13. Construct and display data in bar graphs. Label on the axis with equal whole numbers in intervals of one or more (numerical data) (e.g., multiplies of five, ten, or 100). The other axis will relate to the categories of the graph (categorical data) (e.g., swimming, fishing, boating, and water skiing as the categories of “Favorite Summer Sports”) [6].

14. Construct and display data in line graphs, labeling the vertical axis with equal whole number intervals of one or more and the horizontal axis with continuous data commonly related to time (e.g., hours, days, months, years, and age). Line graphs will have no more than four identified points along a continuum for continuous data. For example, growth charts showing age versus height with age on the horizontal axis (e.g., month, 2 months, 3 months, and 4 months).

15. Interpret the data to answer the question posed, and compare the answer to the prediction (e.g., “The summer sport preferred by most is swimming, which is what I predicted before collecting the data”).

16. Select from among four choices a correct analysis of the data presented in a bar or line graph. For example, given a line graph, show the number of soccer players (in millions) within the U.S. over the time period 1980 to 2000 in five-year intervals. Then select the correct

answer response that relates to the graphs, such as, “The greatest increase in number of soccer players occurred between 1985 and 1990”.

3.4 Key Terms

A. Categorical Data – some questions are answered with adjectives (e.g., gender, favorite color).[6]

B. Bar graph – to represent data in bars. It can be constructed horizontally or vertically. They are usually used for categorical data.[6]

C. Data – systematically recorded numbers or labels used together in context. Information used for organization.[6]

D. Line plots – to represent data on a number line. Categories are counted and a X is used to mark the total.[6]

E. Line graph – a graph to represent data using a line to mark the total. This graph usually shows change.[6]

F. Pictograph – to represent data in pictures.[6]

G. Axis – a horizontal or vertical line to represent the count of the categorical or numerical number.[6]

3.5 Module 1 Vocabulary Booklet [4] [8]

A. Materials
Manila paper
Notebook paper or computer paper
Scissors
Dictionary
Time allotment: 1 day

Overview: Students need to develop a basic understanding of vocabulary before beginning a unit of study. It is always a great idea to introduce the vocabulary words by letting

the students create a graphic organizer with the correct definition. The organizer will be a continuous tool for study.

B. Model Example

The teacher will demonstrate how to make a very simple vocabulary book. The students will fold a sheet of notebook paper in half beginning with paper in vertical position. On one side, they will cut every third line (if using notebook paper). The organizer will result in ten tabs on wide ruled notebook paper and twelve tabs on college ruled. The students will label the tabs with the key terms, one on each line: Data, categorical data, bar graph, line graph, pictograph, line plot, and axis.

C. In Class Assignment

The teacher will place the students into pairs, and they will look for the definitions of each word. When the definitions are found, the students will write them under the tab next to the word and come back to their seats when finished. The teacher will observe each group to make sure students are on task.

D. Homework Assignment

The students are to study their vocabulary booklets for a quiz (Appendix G)

3.6 Module 2 Music Math Vocabulary

A. Materials

Index Cards

Glue

Typed Key Terms (Appendix H)

Typed Definitions (Appendix I)

Laminating Optional

Pictures Optional

Time allotment: 2 days

B. Model Example

The teacher shall review the definitions from Module 3.5. He or she will pass seven index cards to each student with a typed page of Appendix H and Appendix I. Explain to the students that they will paste one word on the front of each index card and the matching definition on the back of each index card. The teacher shall observe and make sure that all students have completed this task.

C. In Class Assignment

The teacher will partner the students and explain that only one set of index cards will be needed in the activity. Each group will sit facing each other on the floor. Once the music starts, one student will begin guessing the words to the definition, while the other student tallies how many answers were correct. When the music ends, the students stop. The student will total up the tally marks and switch. It is now the other students' turn. This activity will help both students to learn words and definitions for statistics. Partners will continue to play and switch partners, depending on time.

D. Homework Assignment

Students will construct a matching game. When they're finished making the game, the word cards are placed face down with definitions face up. The family can be involved by giving hints to the students.

3.7 Module 3 Graph Layered Book

A. Materials

Manila paper or Computer paper

Typed words and definitions

Visual Graphs (Provided by the teacher)

Glue

Scissors

Time allotment: 1 day

Overview: In a classroom, teachers often resort to visual representation. This lesson is developed using a graphic organizer from The Big Book of Math [8] to reinforce the students' understanding of a new concept.

B. Model Example

The teacher will give students two sheets of paper (8 ½ X 11) and they will stack them so that the back sheet is one inch higher than the front sheet. The students shall bring the bottom of both sheets upward and align the edges so that all of the layers or tabs are the same distance apart. When all tabs are of equal distance apart, fold the paper to meet the one inch mark from the second sheet and crease well. The student will then staple them along the top edge of the organizer. [8]

Graphs
line plots
picture graphs
Bar graphs

Figure 6: Organizer-Layered Book

C. In-Class Assignment

When the students are finished constructing the layered book, they will use a sample picture (teacher choice) of each graph in the book. The teacher will begin to hand out the worksheet while explaining the characteristics of a bar graph (used to represent data in bars.) The bars are either horizontal or vertical. The student will cut and paste the word “Graphs” at the top of the layered book, then cut and paste the word “bar graph” on the first flap. The student will cut and paste the definition of bar graph under the flap and will find a picture of a

bar graph from a pre-developed worksheet by the teacher. He or she will ask the student to cut and paste the picture under the flap as well.

The teacher will move on to “Picture Graph” and explain the graph as one that is used to represent data in pictures. The student will cut and paste the word “Picture Graph” on the second flap and paste the definition under the flap. With the assistance of the teacher, the student will find the picture of the pictograph and paste it under the flap as well.

Next, the student will find a picture of a line graph. The teacher will continue to explain a line graph (used to show change). The student will cut and paste the word “Line Graph” on the second flap and the definition of a line graph under the flap. The teacher will ask if there are questions concerning the different graphs.

3.8 Module 4 Favorite T.V. Show

A. Materials

Worksheet “My Favorite” (Appendix J)

Large White Butcher Paper

Yard Stick

Markers

Worksheet “Bar graphs” (Appendix K)

Time allotment: 1 day

Overview: Prior to beginning this module the teacher should send home a “My Favorite” (Appendix J) homework assignment to find out the students’ interests in order to begin graphing.

B. Model Example

The teacher will begin this lesson describing a bar graph, a graph used to represent data with bars. He or she will let the students know that this lesson will focus on their favorite TV show. At this point, the teacher will take up the worksheet “My Favorite” and write on the board some of the different shows enjoyed by the students. For example; “Hannah Montana,”

“That’s So Raven,” “Spongebob Squarepants,” and “The Suite Life of Zack and Cody,” etc. He or she will use tally marks to show the total on the board. The class paper helper will distribute the “Bar graph” worksheet at this time. The teacher will call attention to the vertical axis on the left. It will be used for the numerical count or for the total number of students who liked a TV show. The horizontal axis will be used to show the categories or the name of the TV show. Next, the teacher will begin to set up her large bar graph on the board made out of butcher paper. He or she will make her numerical vertical axis and her horizontal categorical axis. While the teacher is making the categorical horizontal axis, he or she will demonstrate and let the students continue to construct their bar graphs accordingly. The teacher will show the students how to label the horizontal axis. He or she will begin to probe and ask questions. “How many categories do we need? Will it be one for each block?” e.g., The teacher will model for the students how to set up their graphs. On the horizontal axis, the four categories are written in intervals of one such as: number one will be “Hanna Montana,” number two will be “That’s So Raven,” etc. The vertical axis will be number in intervals of two. Students are chosen to come to the board and color in blocks on the large butcher paper according to their sheet. On the board, the teacher will write tally marks of their favorite TV show to match the butcher paper. He or she will continue this process until all shows are graphed.

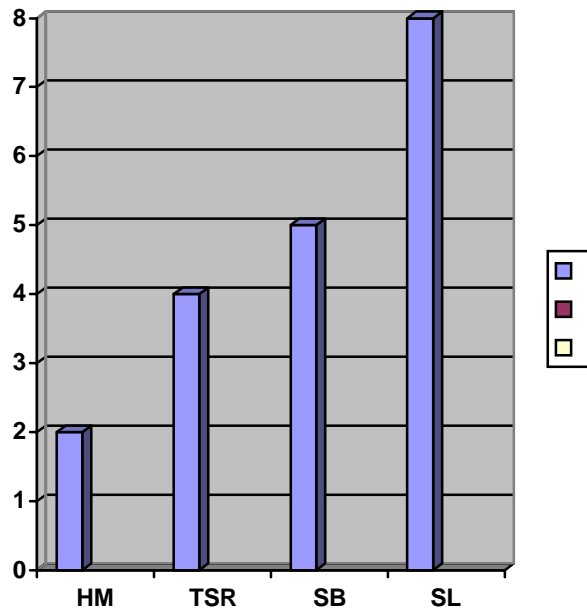


Figure 7 Graph Bar

The teacher will begin asking questions such as, “Which show was the least favorite?” “Which show was the most favorite?” “Are there two shows with equal favoritism?”

C. Class Assignment

Using the same worksheet “My Favorite,” the teacher will tally up the score for the most favorite fast food restaurant. He or she will display the count on the board. For example: McDonalds, Hardee’s, Wendy’s, and Burger King. The students will use the bar graph worksheet (Appendix K) to create their own bar graph for evaluation of lesson.

D. Homework Assignment

Give the students a clean bar graph worksheet (Appendix K) to construct a bar graph of their friends’ favorite restaurants.

3.9 Module 5 3-D Bar Graph Organizer [8]

A. Materials

- Computer paper and Tag board
- Markers or colored Pencils
- Liquid glue
- Ruler
- Overhead Projector
- Overhead Pen

Graphing Paper (Provided by the teacher)
Time Allotment: 2 days

Overview: In this lesson, pupils will use data they collected to create a kinesthetic organizer and build a three-dimensional bar graph.

B. Model Example

The teacher will first explain how to make the three-dimensional bar graph organizer [8]. The students will fold a sheet of computer paper (8 ½ X 11) in half horizontal. Beginning at the fold, or mountaintop, students cut one or more tabs then fold the tabs back and forth several times until there is a good fold line formed, partially open the horizontal folds and push the tabs through to the inside. At this point, the teacher will redirect the lesson back to the graphing. He or she will dispense the worksheet “My Favorite” and, together in class, the students will tally their favorite school subjects trying to stick to four categories. The teacher will write the subjects on the overhead and tally the votes. (e.g., Math 3, Reading 6, Science 2, Social Studies 4).

C. In-Class Assignment

The student will begin working on the top page of the 3-D organizer. Students take their rulers and mark off four straight horizontal lines. On the left side of the axis, the teacher will review the information needed to be put on the vertical axis. (e.g., the number of votes). The students can then begin to number the Y axis or the vertical axis – 0, 2, 4, 6, 8. The teacher will remind them to look at the highest total before beginning to label the graph. The students can begin to cut their tag board. They will make one long strip of paper, glue the ends together, and fold to form a square. The square may need to be modified or cut and re-glued to fit the exact number on the bar graph. When the student matches the tag board and the number, he or she may glue it to fit the graph. The student will continue this process for each category. The

student will label the horizontal axis and each tag board glued. When finished with the inside of the booklet, he or she can make a cover for the book by folding another sheet of paper in half horizontally. The student can place glue around the outside edges of the three-dimensional bar graph booklet and firmly press inside the horizontal cover to seal.

D. Homework Assignment

Using a bag of Skittles and a piece of graphing paper, the student will sort the Skittles by color and graph the results, return the graph the following day, and make sure both axis are labeled including the title.

3.10 Module 6 Pictograph – Favorite Sport

A. Materials

Die cut circles (orange, white, and brown)

Large Butcher Paper

Large White drawing paper 11 X 18

Markers

Yardstick

Rulers

Glue

Time allotment: 1 day

Overview: Using a pictograph will help student's visualize the data with actual pictures.

B. Model Example

The teacher will explain how a pictograph uses multiple pictures to represent bars. He or she will remind the students of the activity "My Favorite." A pupil will pass out the "My favorite" worksheet (Appendix J). The students will look at the worksheet to help them remember what sport they had written down previous. The teacher will display the large butcher paper on the chalkboard and begin to ask the students to raise their hands when they see their favorite sport listed. He or she will write sports up on the board and begin to tally votes (e.g., Basketball 3, Baseball 4, Soccer 2, Football 5). The teacher will begin to ask the

students questions about the horizontal and vertical axis. “Where does the categorical data go? (Horizontal or Vertical) Where does the numerical data go? (Horizontal or Vertical)” The teacher will continue and draw his or her graph on the large butcher paper as in Figure 8.

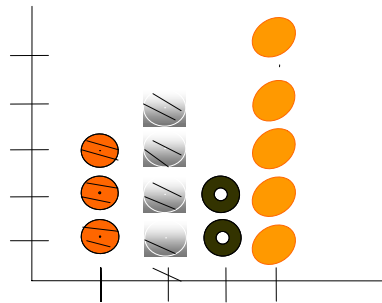


Figure 8: Graph-Picture

C. In Class Assignment

The teacher will now let the students choose the correct die cut circle to color representing their favorite sport. He or she will let the children come up and glue their picture to the large butcher paper to match the horizontal and vertical axis. When the class is finished, the teacher will begin to ask questions, “Which group has fewer? Which group has more? More than 4? Fewer than 3?”

D. Homework Assignment

Using graph paper, a student will complete a pictograph of his or her family’s favorite season, compiling data by calling aunts, uncles, cousins, and grandparents.

3.11 Module 7 Jump Rope

A. Materials

Jump ropes

Ruler

White Drawing Paper

Butcher paper

Time allotment: 6 days

B. Model Example

The teacher will inform students that a line plot is a graph that is used to represent numerical data on a number line. The pupil helper will hand out a large sheet of white drawing paper and a ruler. The teacher will instruct each child to use another sheet of paper to predict the total times each student in the room can jump rope continuously for 30 seconds, separating the boys and girls. The teacher will begin to create a line plot graph while giving complete instructions on how to make a line plot. The students will then make a similar graph. The numerical data is displayed on the y axis(vertical) of the number line beginning with the lowest number and ending with the highest. (e.g., 5, 10, 15, 20) and the date is displayed on the x axis (horizontal). The teacher can begin to test the data. Choosing one student, he or she will begin to jump rope while keeping the time. The teacher can write the students name on the board to keep track of their total. The students will complete their data each day and on the 6th day, their graphs will be completed.

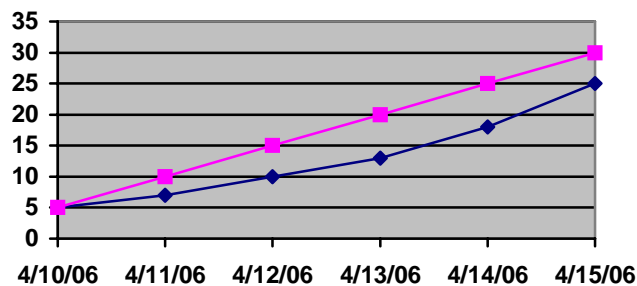


Figure 9 Graph Girls and Boys Jump Rope

C. In Class Assignment

The teacher will ask students to compare predictions and to compare line plots. The students shall draw their own line plot on large drawing paper and write at least one sentence telling about the graph. Then they will differentiate between the girls and boys line plot graph. A conclusion or interpretation shall be included.

D. Homework Assignment

Pretend each student is going to the Pizzeria in New York City to eat pizza. Mr. Rodney kept track of the different kinds of pizza he sold in his restaurant during one lunch hour for two days. He sold 10 hamburger pizzas, 5 supreme pizzas, 2 vegetable pizzas, and 15 pepperoni pizzas the first day. Mr. Rodney sold 11 hamburgers, 7 Supreme, 5 Vegetable, and 25 pepperoni pizzas on the second day. Use this data to make a line plot graph.

3.12 Module 8 Watching the Weather [1]

A. Materials

Measure Air Temperature Chart (any thermometer on paper)

Thermometer

Line Graph

Watching Weather Chart (appendix L)

Watching the Weather Worksheet (appendix M)

Internet/Computer

Calendar

Weather Pictures

Ruler

Time allotment: 1 Month

B. Model Example

As the teacher begins this unit on weather, he or she will review line, bar, and pictographs. Line graphs are graphs that are used to represent numerical data using plots and lines. They show a change in a collection of data. This lesson incorporates bar graphs, pictographs, and line graphs.

The teacher will pretest the students' ability to read Celsius and Fahrenheit thermometers. The student board helper will go to the outside window, or wherever the thermometer may be, and read it. He or she will then come over to the board and write the temperature on the board. The students will get their "Measure Air Temperature" thermometer worksheet and use a red colored pencil to color in the temperature. The teacher will keep track of these temperatures for 1 month on his or her personal thermometer worksheet. After the thermometers are completed, the teacher will check each worksheet for accuracy and file the sheets in the students' mailboxes. The student board helper will look outside and describe the weather for the day (e.g., Cloudy, foggy, hail, rainy, partly cloudy, snowy, sunny, or windy). When the board helper has displayed the weather picture on the calendar, the other students can begin to draw their picture on the "Watching the Weather" worksheet (Appendix M) (depending on what day the lesson begins). This will be a daily process during math class for twenty days. At the end of twenty days, the next step will begin [1].

C. In Class Assignment

The teacher will instruct the students to look at their "Watching the Weather" worksheet (Appendix M) and begin their "Watching Weather Chart" worksheet (Appendix L). The teacher will draw attention to the importance of counting each day. The helper will count, take up both worksheets, and make sure both are stapled together. The teacher will then begin to use his or her "Measure the Air Temperature" to teach line graphs. There should be at least twenty temperatures recorded for line graphing. He or she will explain how to put a dot for each temperature collected. The dot must go right on the line. When two dots are finished, the students will use a ruler and draw a straight line to connect the dots. Explain that this graph will show a change in temperature, from cold to warm and hot to cold.

The students will go to www.weather.com and check the temperature sometime in the afternoon. He or she will record the temperature in the chart for one week and make a line graph using a worksheet given by the teacher.

D. Homework Assignment

The student will predict the temperature for the following day. Using the record sheet, he or she will log the temperature. For 10 days, the students will continue to log the temperature and turn their assignments in when finished.

3.13 Module 9 Survey Says

A. Materials

Survey Worksheet 1 (Appendix N)

Pencil

Crayons

Colored Pencils

Time allotment: 1 day

B. Model Example

The teacher shall explain to the students what a survey is and its purpose. This particular survey is an in-class survey but some surveys have been done with other classrooms. The teacher will explain to the students that they will be asking each of their classmates to choose a favorite topic. They should brainstorm a few minutes and decide on what they would like to ask. Some suggestions might be sports, food, singers, songs, subjects, games, or anything that interests them.

The student will write one question at the top of the bar graph activity paper. (Appendix N) The students will then write five answer choices to go along with their question. The teacher will let the students begin to ask each of the classmates their questions. The teacher may choose to let a few students ask questions first. If the entire room is roaming around, some of the

students come up short on their answers. They will record answers by using tally marks beside the choices.

C. In Class Assignment

When the class is finished, the students will sit at their desks and be sure they have a total count for all students. Then they may begin constructing bar graphs that will include a title, and a horizontal and vertical axis.

D. Homework Assignment

The students will conduct a one-week survey. (How Many Times in a week (Monday – Monday) will your family sit down at the table to eat a family dinner? Use chart below - On Tuesday turn in with Bar Graph.

DAY	AMT. OF TIME SPENT AT THE TABLE EATING A FAMILY DINNER
MON.	
TUES.	
WED.	
THURS.	
FRI.	
SAT.	
SUN.	

Figure 10 Chart-Survey Says

4 PROBABILITY FOR FIFTH GRADE UNIT

4.1 Introduction

Probability is the chance of an event occurring. The probability of an event occurring is the ratio of a particular outcome to the total number of possible outcomes.

The probability of an event occurring is represented by a ratio between 0 and 1. An event is “impossible” if it has a probability of zero (e.g., the probability that the month of April will have thirty-one days). An event is “certain” if it has a probability of one (e.g., the probability that the sun will rise tomorrow morning). When a probability experiment has very few trials, the results can be misleading. The more times an experiment is performed repeatedly, the closer the experimental probability comes to the theoretical probability (e.g., a coin land heads up half of the time).

Students should have opportunities to describe in informal terms (e.g. impossible, unlikely, likely, and certain) the degree of likelihood of an event occurring. Activities should include real-life examples. For any event such as flipping a coin, the equally likely things that can happen are called outcomes. For example, there are two equally likely outcomes when flipping a fair coin: the coin can land heads up, or the coin can land tails up.

A sample space represents all possible outcomes of an experiment. The sample space may be organized in a list, chart, or tree diagram. Tree diagrams are drawn to show all of the possible combinations (outcomes) in a sample space. The counting principle tells how to find the number of outcomes when there is more than one way to put things together. For example, how many different outfit combinations can you make from two shirts (red and blue) and three pant combinations (black, white, and brown)? The sample space displayed in a tree diagram

would show that two times three equals six (counting principle) outfit combinations equals red-black; red-white; red-brown: blue-black: blue-white: blue-brown [6].

4.2 Standards of Learning

The standards of learning are as follows:

1. Solve problems involving the probability of a single event by using tree diagrams or by constructing a sample space representing all possible results.
2. Predict the probability of outcomes of simple experiments, representing it with fractions or decimals from 0 to 1, and test the prediction.
3. Create a problem statement involving probability based on information from a given problem situation. Students will not be required to solve the created problem statement.

4.3 Essential Knowledge and Skills

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to:

1. Construct a sample space, using a tree diagram to identify all possible outcomes of a single event.
2. Construct a sample space, using a list or chart to represent all possible outcomes of a single event.
3. Determine the probability of a single event when the total number of possible outcomes is twelve or fewer.
4. Determine the outcome of an event that is least likely to occur (0) or most likely to occur (1) when the number of possible outcomes is twelve or fewer.
5. Create a problem statement involving probability based on information from a given problem situation. Students will not be expected to solve the problem [6].

4.4 Key Terms

1. Sample Space: the set of possible outcomes.[6]
2. Tree Diagram: a diagram used to organize outcomes of an experiment. [6]
3. Ratio: a pair of numbers that shows a comparison of two quantities and can be written as 9:4, $\frac{9}{4}$, or 9 to 4. [6]
4. Outcome: a result in an experiment.[6]
5. Impossible: an event that can never happen.[6]
6. Unlikely: not guaranteed to happen.[6]
7. Equally likely: having the same chance of occurring.[6]
8. Certain: an event that will always happen.[6]

4.5 Module 1 Probability-Vocabulary

A. Materials

Scissors

Glue

Paper

Time allotment: 2 days

Overview: Introduce the probability unit using the vocabulary terms and making a four-tab book divided into eighths [8].

B. Model Example

The teacher will give an overview of the vocabulary terms. He or she will then explain the detailed instructions on how to make a four-tab book divided into eighths for the eight vocabulary terms needed for the probability unit. The students will fold a sheet of paper ($8\frac{1}{2} \times 11$) in half horizontally, then fold this long rectangle in half again continuing the process to make lines of symmetry. The students should now have eight sections. The students need to put

one finger inside the fold to ensure that they do not cut both pieces of paper. They are to take their scissors and cut their top flap on each fold, only cutting to the middle fold.

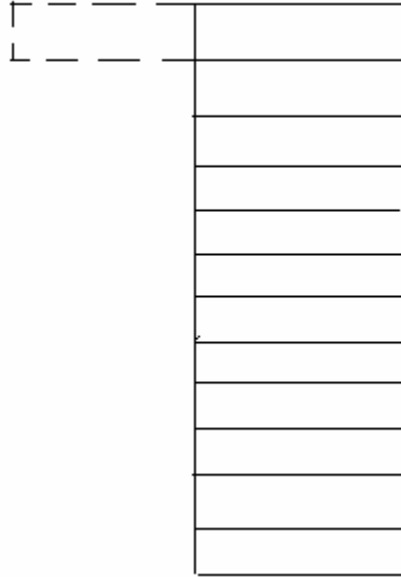


Figure 11 Organizer-Vocabulary

C. In-Class Assignment

The teacher will instruct the students to paste their words on the outside flap of the organizer, paste their definitions on the inside flap of the organizer, and then illustrate on the bottom flap of the organizer. The teacher may want to brainstorm illustrations first.

C. In Class Assignment

The teacher will put the students with partners. The first task is to identify the sums that are possible when rolling two 1-6 number cubes. The students will predict which sum will appear the most and explain their predictions. Task number two will be to roll the number cube twelve times and record the outcome in a tally chart.

(2,4,6) Multiples of 2	7
Not Multiples of 2 (1,3,5)	5

Figure 13 Chart Tally

The teacher will walk around to each pair and observe how students make their predictions and conduct their experiments. To further thinking, the teacher will ask, “How can listing possible outcomes help them predict results? What’s an easy way to record the results of the experiment?” After students show their work, they will summarize the methods they used to make predictions and express their results in writing. How did you make your predictions? If no one student listed every possible outcome, ask, “How can making an addition table for 1-6 help make a prediction?”

Example summary for this prediction: This student made an addition table for the numbers 1 to 6. He or she counted the number of ways to make each possible sum. Since seven had the most chances, he or she predicted that seven would come up the most.

2 (1 time)	8 (5 times)
3 (2 times)	9 (4 times)
4 (3 times)	10 (3 times)
5 (4 times)	11 (2 times)
6 (5 times)	12 (1 time)
7 (6 times)	

Figure 14 Chart-Prediction

Example Summary: This student made a line plot of the results.

Sample #3 The sums are two to twelve. There are more ways to get a sum in the middle than a sum that is high or low, so he or she predicted six would come up most often. Six came up three out of ten times. So did seven. But, eight came up two times. This didn't match the student's predictions.

Discuss strategies a student may use to make predictions. Point out that listing possible outcomes help to compare the likelihood of each outcome [2].

D. Homework Assignment

The students will list 12 possible sums of rolling the number cubes. For each sum, they will write a fraction in which the numerator is the number of possible ways of rolling the sum and the denominator twenty. These results are used to compare the likelihood of rolling different sums, such as eight and eleven.

4.7. Module 3 Name Drawing [2]

A. Materials

Paper

Pencil

Tally sheet (notebook paper)

Shoe box

Time allotment: One day

B. Model Example

The teacher will explain to the students that probability is the chance of an event occurring. The lesson will focus on the chance that when the names of twelve classmates are put in a shoe box, what degree of likelihood that a name that begins with a letter D will be drawn out of the box. The teacher will then allow the students to write their names in their best handwriting onto a piece of paper (probably in print) and collect. The teacher will then split the students in two groups of twelve providing he or she has twenty-four students.

On another sheet of paper, allow the students to predict the degree of likelihood (e.g., use terms such as certain, likely, unlikely, and impossible). At this grade level, the teacher will want to review the key terms. After the students have written their predictions, allow them to make a number prediction using a fractional representation (e.g., impossible $0/1$; equally likely $5/10$ certain $1/1$), or a third grader might say 1 out of 4. The teacher will begin with the experiment drawing names out of the shoebox.

C. In Class Assignment

The teacher will group the students into pods of 6 with 4 in each pod. Each group will be provided with a shoebox, paper, pencil, and tally sheet. The students can decide among themselves on how to distribute the jobs. This will allow the students to accept some responsibility for their group activity. The teacher will instruct the students to write their last names on the sheet of paper this time. They will conduct the experiment the exact same way except their sample space will be smaller. He or she will pause and ask the students if they may know why the sample space is smaller, hopefully the students will answer with a response of because they're fewer students in a group. The teacher will remind them to conduct two different predictions on paper with the actual answer. When the students finish, the teacher will

bring the class back to whole group and ask the students who did the actual tallying to share the information with the class.

D. Homework Assignment

Conduct the same experiment at home using first names of family members only. Write one paragraph describing their prediction and the actual outcomes.

4.8 Module 4 Who Wants to be a Millionaire? [2]

A. Materials

Spinners (Appendix E) [8]

Large Paper Clips

Time allotment: 1 day

B. Model Example

The teacher may ask the students if they have seen the game show “Who Wants To Be a Millionaire?” and then explain that using spinners is similar to playing this game. The teacher will invite one student to come up in front of the room to demonstrate the activity. The teacher and student will take a spinner that is cut into four equal parts. The student or teacher will write his or her name in two of the parts while the other person writes his or her name in one other part. Then, in the last part, “divide equally” will be written. The teacher and student will imagine they are given a million dollars. Before the student spins, the class will predict the result. The student can spin to see who will receive the money. The teacher can then discuss using vocabulary terms “equally” and “more or less likely”. Once the spinner lands, discuss the outcome.

C. In Class Assignment

The teacher will partner the students. He or she will give them one spinner and a large paper clip. Partner one will write his or her name in two sections of a spinner. Partner two

writes his or her name in a third section. Then one partner will label the fourth section “Divide evenly.”

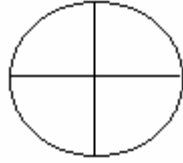


Figure 15 Spinner Four-Section

Make sure predictions come first. Partners imagine they are given a million dollars. The teacher will flip a coin to see who will go first – if the coin lands on heads, section number two will go first. As the students are playing the teacher will be observing. The teacher will discuss with each group their results and then have students predict the results for forty spins and carry out the experiment.

The teacher will bring the whole class back together and share results. One student will come to the front and give outcomes and predictions from the group. The teacher will lead in more probability strategy questions [2].

D. Homework Assignment

Allow enough time for every student to make a spinner. Each student will take home a spinner and play “Who Wants to be a Millionaire” with a family member. The students will discuss uses of the money with their families. Each student will write and illustrate the conclusion of the family decision.

4.9 Module 5 Moon and Stars [2]

A. Materials

25 Index Cards cut in half

Paper bag or box

Time allotment: 1 day

Overview: In this lesson, the student uses fractions to represent the probabilities of events.

B. Model Example

The teacher will explain that fractions can be used to represent the probability of an event. For example (there are 6 sides when rolling a die; therefore a fraction will look like $\frac{1}{6}$). The teacher will explain today's lesson as being similar. His or her bag of stars, moons, triangles, and rhombuses have been made. The teacher will model the lesson.

As a whole class, the students will count the total number of cards (50). On the board, the teacher will write 50 showing it as the denominator. He or she may ask, "How can we find the number of moons there are in the bag? (By counting them). The teacher will then count all of the moon cards. On the board, he or she would write the number of moon cards as the numerator. (e.g., answers will vary). The fraction showing probability will be $\frac{10}{50}$ for moons. The teacher will continue to use reasoning assessment. If all the cards were moons, what will be the probability of drawing a moon? (1) A star? (0). Using vocabulary terms, the teacher will reinforce the words certain and impossible.

C. In Class Assignment

The students need to agree on four common shapes to draw on the index cards. (circle, square, triangle, and star) Students draw symbols on the cards until they make 50 cards and then place the cards in the bags. The students will begin taking turns removing and replacing the cards approximately ten times. As the students draw the cards, they will write their fractional representation on notebook paper. The teacher will close by asking if there are any questions and continue with an on-going assessment with this activity [2].

D. Homework Assignment

Make a new set of cards with different shapes and fractional representations.

4.10. Module 6 Fair Game

A. Materials

Spinners [8] (Appendix E)

Large wipe off spinner with five sections

Large paper clips

Paper

Pencils

Time allotment: 1 day

Overview: Students will use probability to decide if a game is fair or unfair.

*A fair game is one in which all players have an equal chance of winning.

*An unfair game is one in which players do not have an equal chance of winning.

B. Model Example

Before the unit of probability, the teacher will make several large wipe off spinners for students' use. (e.g., one that can be written on with a overhead pen or dry erase marker, a spinner that's blank and laminated). He or she will explain the "fair and unfair" game first, and then choose one student to come forward. The student will write his or her name in two sections of the five-section spinner on the board, and the teacher will write his or her name on two other sections of the board. The student can write "spin again" in the fifth section.

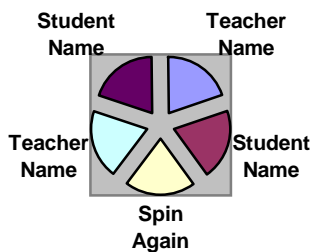


Figure 16 Spinner-Five Section

Discuss the idea of equal chance and fair game. The teacher will point out that the mathematical meaning of a “fair game” has nothing to do with cheating.

The teacher asks, “What is the probability of spinning your name?” “Is the probability the same for both of you?” (Yes) The student will spin and conduct the model example to see who will win the spin.

C. In-Class Assignment

The teacher will put the students into partners. Each partner will write his or her name in two sections and have one partner write spin again in the fifth section. The teacher will have pairs spin a few times, and keep track of results. The teacher will explain that because each student has the same chance of spinning his or her name, the game is fair. The teacher will bring the class back together and let each group share their results and discuss all questions.

D. Homework Assignment

The students will design one game that is fair using these guidelines:

What are the rules?

How do you win?

How many people play?

How do players score points?

What materials are used in the game?

What do players do on their turn?

What is the title of the game?

4.11 Module 7 Sandwich Making

A. Materials

Paper

Pencil

Time allotment: One day

Overview: The students are required to use tree diagrams as a visual representation of all possible outcomes and to illustrate the Fundamental Counting Principle, (a choice that is made in x ways, then for each of these choices, a second choice is made in y ways, so the first and second choices are displayed as xy ways.

B. Model Example

The teacher will review that a tree diagram is a diagram used to organize outcomes of an experiment. The objective of this lesson is to find all the possible outcomes of making a sandwich by constructing a tree diagram or by multiplying. The teacher may want to review basic multiplication facts. Vertical or horizontal tree diagrams will work depending on the students' preference. The teacher will point out on the board how each diagram will look as he or she begins.

The teacher will begin modeling by having a student come forward. On the board, write "Bread", "Filling", "Outcome." Inform the students there will be two kinds of bread, (white or wheat). 3 varieties of meat will include turkey, ham, or roast beef . We will use this as an example.

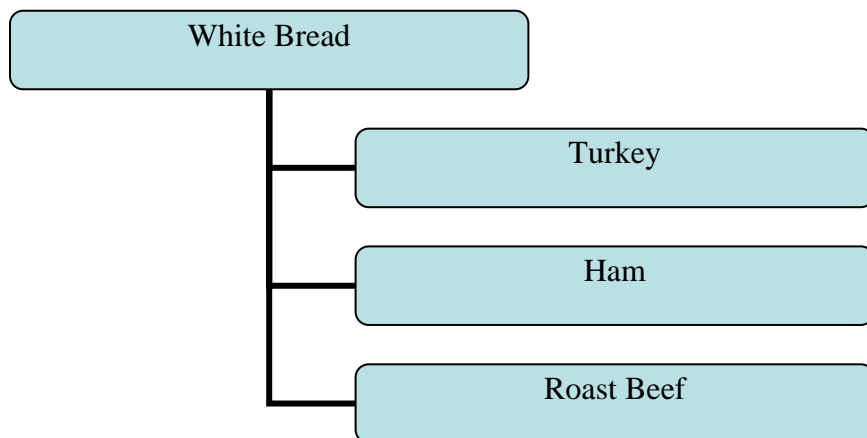


Figure 17 Diagram-Tree 1

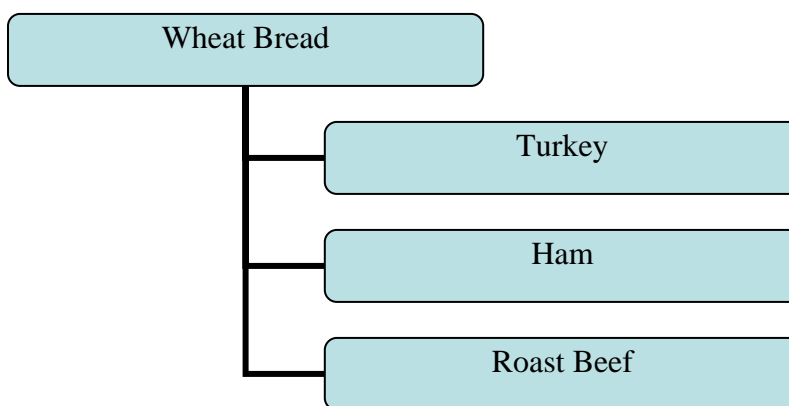


Figure 18 Diagram-Tree 2

Let the students know the number of outcomes is the product of the number of choices. For example, two kinds of bread times three choices of meat will equal a product of six or the Fundamental Counting Principle.

The teacher shall ask if there are any questions.

C. In Class Assignment

The teacher will group the students into pairs and say, “This is the tree diagram question with 3 kinds of bread and 3 meat choices. What are the different possibilities for these sandwiches?” The students will work in their pairs to make the diagrams. Then they will work

the algorithm for the multiplication principle. Each group shall discuss the number of outcomes. They will contemplate their answers to ensure it is the product of the number of choices. As the teacher is observing, he or she will give them an additional tree diagram: keep the same amount of bread, add 2 more fillings that will give them a total of 5 and add 2 trimmings like lettuce and tomatoes. How many different outcomes are there? Do the counting principle and the tree diagram. The teacher will organize students as a whole and then share their results.

D. Homework Assignment Buying a New Car –

The Smith Family is going to purchase a new car. At the dealership, the sales person tells them that for the model they like, the Zephyr Zoom, there are several options. The exterior of the car can be black, white, or red. The interior of the car can be tan, red, and blue.

1. How many different combinations are possible for ordering a car?
2. Draw the tree diagram and use the fundamental counting principle.
3. Include an illustration of the vehicle.

4.12 Module 8 Tangram Ratios [2]

A. Materials

Tangram copy [8]

Crayons

Markers

Scissors

Time allotment: 1 day

Overview: The students at this level will use this lesson to build an understanding of ratio.

B. Model Example

To review, the teacher will explain a ratio is a pair of numbers that show a comparison of two quantities and can be written as 9:4, $\frac{9}{4}$, or 9to4, but using different numbers. The teacher will begin by writing on the board: part-to-part, part-to-whole, and whole-to-part. The

teacher will have her pieces colored and cut out for demonstration. He or she will show that four of them are red and three are blue (One example of a part-to-whole ratio). The teacher will begin to ask several questions. “What is the ratio for the Tangram pieces?” (5 to 7) Show 5 to 7, 5:7, and $\frac{5}{7}$. A part-to-part ratio the teacher could write would be 4 red pieces to 3 blue pieces, or 4 to 3 and show: 4 to 3, 4:3, and $\frac{4}{3}$.

C. In-Class Assignment

The teacher will pair students and give them the “Tangram” worksheet. They will cut it apart and color their shapes. The students will begin by writing an example of a part-to-part whole ratio, which is the number of shapes in all and a part-to-part ratio. The teacher will then have the students write 3 different ratios using the tangram pieces. The teacher will observe each group and discuss what would be the whole-to-part ratio they could write from the tangram shapes. (Sample answer: 7 shapes to 5 triangles.) The teacher will conduct share time when bringing the class back as a whole group to review concept of a ratio [2].

D. Homework Assignment

Write name on a sheet of paper and separate consonants and vowels.

Write the part-to-part ratio.

Write the part-to-whole ratio.

4.13 Module 9 Measures of Central Tendency

A. Materials

Manila Paper

Scissors

Markers

Dictionary

Time allotment: 1 day

Overview: This lesson will give the students an opportunity to understand the definitions of mean, median, mode, and range.

B. Model Example:

The teacher will begin the lesson by describing measures of central tendency and why it is helpful to understand the concept. When analyzing data, it is helpful to have one number that describes the set of data: mean, median, mode, and range. The teacher will discuss each word and its definition. Mean is the average of a set of data. Median is the middle number in a set of data. Mode is a number in a set of data that is expressed most often. Range is the lowest number in the data subtracted from the highest number in the data.

C. In-Class Assignment:

The students will begin by folding a sheet of manila paper in half from the vertical position. They will open their paper and trace the line of the fold with a pencil or marker. The students will then fold the short sides to meet the middle. Next, the students will fold the top to the bottom, open, and cut along the second fold to make four tabs.

The students will write each word, (mean, median, mode, range) on the outside of each tab, one word on each tab. They will open the first tab and begin to write the definition of mean from the glossary in the back of a dictionary. This process will continue until all words are completed. The teacher will observe by walking around the room.

D. Homework Assignment

Short Quiz

4.14 Module 10 Calculations

A. Materials
Notebook Paper
Set of data
Calculator

Time allotment: 1 day

Overview: The students will get a better understanding of measures of central tendency by manipulating data.

B. Model Example

The teacher will begin by asking students to write down their full name including their middle name. The students will write down how many letters are in their names. The teacher will write the data down on the board. The teacher will include the amount of letters in his or her name as well. On the manila paper, the students will write the data too. To begin, the teacher will explain the definition of mean. The teacher will add the letters of the students' names on a calculator then divide by the total number of students. For example, if there are 20 students and 1 teacher, they will divide by twenty-one. Each student will write the steps on how to calculate the mean or average, then write the mean on the bottom of the organizer made in Module 4.12.

Next, the teacher will explain the definition of median, the middle number after the data are ordered from the least to the greatest. The teacher will model how to eliminate the numbers from the left and then the right. This process will allow the middle number to appear. If two numbers were to be the middle, the teacher will explain how to take those two numbers, add them together, and then divide by two. The students will write each step on the bottom of the organizer from Module 4.12 along with the median number.

The teacher will now explain the definition of mode, the number that appears most often in a set of data. Again, the data must be in order from the least to the greatest. On the organizer, the student will write the steps to finding mode and then write the mode of the set of data. The teacher will tell the students that sometimes there may not be a mode.

Last, the teacher will demonstrate how to find the range of a set of data. In this particular measure, the data will not need to be in order from least to greatest. The student will find the highest number and the lowest number, then subtract. The student will write the steps on the organizer under the heading range.

D. Homework Assignment:

Using any set of data from the Scotts Foreman source [2], the students will find the mean, median, mode, and range. They will write the data in order from the least to the greatest and find each measure.

5 SUMMARY

Because the probability and statistics units were designed for the third through fifth grade teacher, it was appropriate to incorporate the probability unit in the classroom of the author. (Note: a third grader will take somewhat longer when beginning with key terms.) They are important to young students because of building math vocabulary. During a unit in science or history, key terms are taught to introduce concepts and to ensure that the student is taught true meanings of words. Math is no different.

The teacher will identify key terms and the students will understand what he or she is speaking about. The probability lesson included a day on Module 2.5 and two days on Module 2.6. The fourth day, a game, "Pass the Ball, Module 2.7 was used for reviewing. The students were actively engaged learning math terms because it was something enjoyable. By the fifth day, the students were ready for their quiz on probability key terms. The students wanted to continue to play the game everyday.

The probability activities continued with the students and some of the activities were less challenging than others. Module 2.10, flip a coin for goods and services was very creative; the students loved incorporating the economics aspect, but the challenging part was illustrating the businesses. For future reference, the businesses might be prepared beforehand for the younger students. Positive results were seen within the classroom. Differentiated instruction was modeled throughout as needed. From the successful testing of the unit, hopefully the other intermediate teachers in the local area will incorporate these valid activities into their probability and statistics units.

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APPENDICES

APPENDIX A

KEY TERMS – PROBABILITY 2.6

PROBABILITY

IMPOSSIBLE

UNLIKELY

EQUALLY LIKELY

LIKELY

CERTAIN

APPENDIX B

DEFINITIONS–PROBABILITY 2.6

A CHANCE OF AN EVENT OCCURRING.

NOT CAPABLE OF OCCURRING OR BEING ACCOMPLISHED.

NOT GUARANTEED TO OCCUR.

AN EQUAL CHANCE OF SOMETHING OCCURING.

LIKELY TO OCCUR.

DEFINITELY WILL OCCUR

APPENDIX C

QUIZ-THIRD GRADE 2.7

Name:

Date:

Sol 3.21, 3.22, 3.23

Quiz on key terms

Directions: match the correct letter with the correct definitions.

Word bank:

a. Probability	d. Equally likely
b. Impossible	e. Likely
c. Unlikely	f. Certain

_____ 1. An equal chance of an event happening.

_____ 2. Having or showing a strong chance of an event happening. (e.g., it is _____ to rain soon).

_____ 3. Not capable of happening. (e.g., it is _____ for the month of April to have 31 days).

_____ 4. The chance of an event occurring.

_____ 5. It has a probability of one (e.g., the sun will rise tomorrow).

_____ 6. Not likely to happen. (e.g., it is _____ for southwest Virginia to have a tornado).

APPENDIX C

CONTINUED ANSWER KEY 2.7

1. D
2. E
3. B
4. A
5. F
6. C

APPENDIX D

QUIZ - FOURTH GRADE 2.7

Name:

Date:

Sol 4.21, 4.22, 4.23

Quiz on key terms

Directions: match the correct letter with the correct definitions.

A. Probability	e. Equally likely
B. Impossible	f. Likely
C. Unlikely	g. Certain
D. Outcome	

_____ 1. An equal chance of an event happening.
e.g., flipping a quarter

_____ 2. Having or showing a strong chance of an event happening. e.g., it is _____ to rain soon.

_____ 3. Not capable of happening. e.g., it is _____ for the month of April to have 31 days.

_____ 4. The chance of an event occurring.

_____ 5. It has a probability of one. e.g., the sun will rise tomorrow.

_____ 6. Not likely to happen. e.g., it is _____ for southwest virginia to have a tornado.

_____ 7. The equally likely chance events can happen. e.g., when flipping a coin, heads or tails will appear.

APPENDIX D

CONTINUED ANSWER KEY

1. E

2. F

3. B

4. A

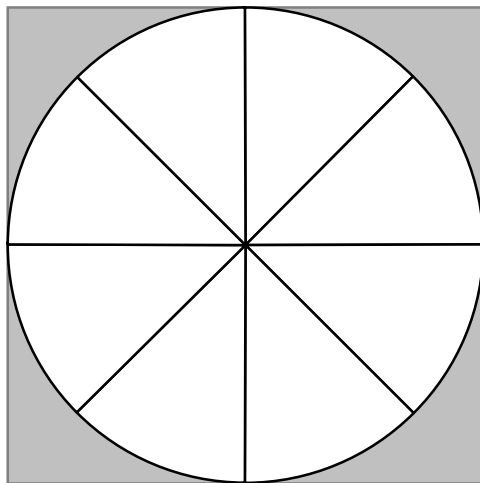
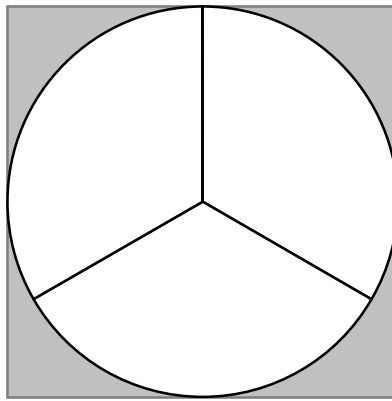
5. G

6. C

7. D

APPENDIX E

REPRODUCIBLE SPINNERS 2.8



APPENDIX F

QUESTIONS-INDEX SPINNER

1. What is the probability of getting the color _____?
2. If name spins this spinner one time, which color is the spinner MOST LIKELY to land on?
3. If you spin the spinner, what is the probability of the pointer stopping on any number?
4. If you spin the spinner one time, which color is the spinner LEAST LIKELY to land on?
5. If you spin the spinner one time, which color is the spinner EQUALLY LIKELY to land on?

APPENDIX G

QUIZ - STATISTIC VOCABULARY WORDS 3.5

- | | | |
|---------------|---------------------|---------|
| A. Pictograph | D. Categorical Data | G. Axis |
| B. Bar Graph | E. Data | |
| C. Line Graph | F. Line Plot | |

Directions: Match the letters with the correct answer.

_____ 1. A graph used to represent data in bars. It can be constructed horizontally or vertically.

They are usually used to compare data.

_____ 2. A graph used to represent data on a number line. Students count categories and use an X to mark the total.

_____ 3. A graph used to represent data in pictures.

_____ 4. Information used for organization.

_____ 5. To classify information or to organize information in certain categories.

_____ 6. A horizontal or vertical line used to represent the count for the categorical data.

_____ 7. A graph used to represent data that uses a point to mark the total.

APPENDIX G

CONTINUED ANSWER KEY 3.5

1. B
2. F
3. A
4. E
5. D
6. G
7. C

APPENDIX H

KEY TERMS – STATISTICS 3.6

CATEGGORICAL DATA

BAR GRAPGH

DATA

LINE PLOTS

LINE GRAPH

PICTOGRAPH

AXIS

APPENDIX I

DEFINITIONS– STATISTICS 3.6

*TO CLASSIFY INFORMATION OR ORGANIZE INFORMATION IN CERTAIN CATEGORIES.

*REPRESENTS DATA IN BARS. IT CAN BE CONSTRUCTED HORIZONTALLY OR VERTICALLY. THEY ARE USUALLY USED TO COMPARE DATA.

*INFORMATION USED FOR ORGANIZATION.

*REPRESENTS DATA ON A NUMBER LINE. YOU COUNT CATEGORIES AND USE A x TO MARK THE TOTAL.

*A GRAPH THAT REPRESENTS DATA THAT USES A LINE TO MARK THE TOTAL. THIS GRAPH USUALLY SHOWS CHANGE.

*REPRESENTS DATA IN PICTURES.

*A HORIZONTAL OR VERTICAL LINE THAT REPRESENTS THE COUNT FOR THE CATEGORICAL OR NUMERICAL COUNT.

APPENDIX J
“MY FAVORITE”

1. T.V. SHOW _____
2. FOOD _____
3. SPORT _____
4. COLOR _____
5. SEASON _____
6. BOOK _____
7. HOLIDAY _____
8. SCHOOL SUBJECT _____

APPENDIX K

WORKSHEET - BAR GRAPH

APPENDIX M

WORKSHEET - WATCHING THE WEATHER

	MONDAY	TUESDAY	WED.	THURS.	FRI.
WEEK 1					
WEEK 2					
WEEK 3					
WEEK 4					

APPENDIX N

WORKSHEET - SURVEY

1. Write your question here _____

2. Write the five answer choices here:

a. _____

b. _____

c. _____

d. _____

e. _____

3. Ask your friends your question.

4. Record each child's answer by making a tally mark in #2.

5. Label and color a bar graph.

APPENDIX O

KEY TERMS – PROBABILITY 4.5

SAMPLE SPACE

TREE DIAGRAM

RATIO

OUTCOME

IMPOSSIBLE

UNLIKELY

EQUALLY LIKELY

CERTAIN

APPENDIX P

DEFINITIONS—PROBABILITY 4.5

*THE SET OF ALL POSSIBLE OUTCOMES

*A DIAGRAM USED TO ORGANIZE OUTCOMES OF AN EXPERIMENT.

*A PAIR OF NUMBERS THAT SHOW A COMPARISON OF TWO QUANTITIES AND CAN BE WRITTEN AS 9:4, $9/4$, or 9 to 4.

*A RESULT IN AN EXPERIMENT

*AN EVENT THAT CAN NEVER HAPPEN.

*NOT LIKELY TO HAPPEN

*HAVING THE SAME CHANCE OF OCCURRING.

*AN EVENT THAT WILL ALWAYS HAPPEN.

APPENDIX Q

QUIZ- DEFINITIONS 4.5

Name:

Date:

Directions: Match each letter to the correct definition. Use the word bank

a. sample space

d. outcome

g. equally likely

b. tree diagram

e. impossible

h. certain

c. ratio

f. unlikely

1. ____ An event that can never happen
2. ____ A pair of numbers that shows a comparison of two quantities and can be written as $9=4$, $9/4$, or 9 to 4 .
3. ____ The set of all possible outcomes.
4. ____ Having the same chance of occurring.
5. ____ A diagram used to organize outcomes of an experiment.
6. ____ A result in an experiment.
7. ____ Not guaranteed to happen.
8. ____ An event that will always happen.

APPENDIX Q

CONTINUED ANSWER KEY 4.5

1.E

2.C

3.A

4.G

5. B

6. D

7. F

8. H

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