

KINDERGARTEN MATH #7

DATA ANALYSIS & PROBABILITY

Data Analysis & Probability shows how to display quantitative comparisons graphically. It introduces the estimation of likelihood.

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This is the last of the seven levels of the troubleshooting guide for KINDERGARTEN MATH. See Summary for details on all seven levels.

These lessons are designed for kindergarten, but they may be applied to anybody to fill earlier blanks in understanding.

Start with the Diagnostic. If the diagnostic fails, then do the Lesson & Exercise.

Follow these guidelines.

- (a) When helping, make sure you have the attention of the student.*
- (b) If you lose the attention, then go back to the point in the lesson where the student was attentive. Then come forward checking student's understanding.*
- (c) Always approach any situation in an affectionate and relaxed manner.*
- (d) Always encourage the student to ask questions.*
- (e) Carefully listen to what the student has to say, and let the student know that you have heard him (or her).*
- (f) Answer all questions matching the interest and understanding of the student.*
- (g) Always talk to the student at his (or her) level. Use only those terms and words that the student can easily understand.*
- (h) When teaching a new concept, ask the student to think examples of his own. Allow enough time even days to let that happen.*
- (i) Get the student involved and thinking with mathematical principles.*
- (j) In the final analysis, make sure that the student can apply mathematics with confidence.*

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DIAGNOSTICS & LESSONS

☺ Diagnostic K7.1 Graph Answers for Two Choices

To pass, the student should be able to display answers to simple questions involving two categories or choices using concrete materials or pictures on a graph or chart with confidence.

"Display the following two choices graphically."

- (a) 3 people chose CAT as their favorite pet
- (b) 4 people chose DOG as their favorite pet

If the diagnostic fails, then do the Lesson & Exercise.

Lesson & Exercise

In this lesson the student displays answers to simple questions involving two categories or choices using concrete materials or pictures on a graph or chart (for example, in a class, number of boys and girls, students with buttons and students with no buttons).

- (a) Start the lesson.

"In this lesson we are going to display answers to simple questions involving two categories or choices."

- (b) State what you are going to display.

"Let's display the information that 3 people chose CAT as their favorite pet, and 4 people chose DOG as their favorite pet."

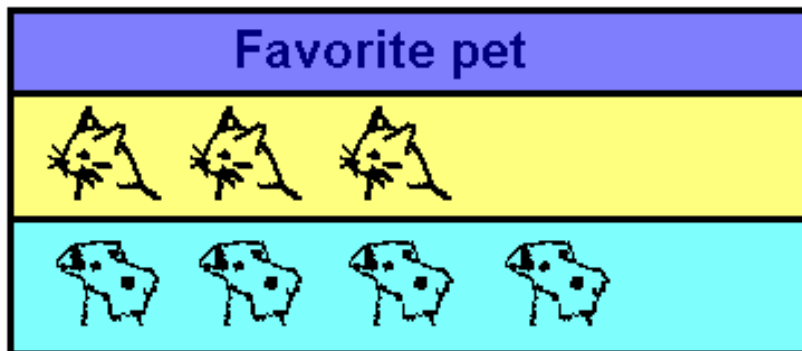
- (c) Describe the method.

"We draw a cat for each choice made for cat in one row."

"We draw a dog for each choice made for dog in another row."

- (d) Show the following picture graph.

"This is a PICTURE GRAPH, which displays the information about favorite pet."



- (e) State what you are going to display.

"Let's display the information that a class consists of 5 boys and 3 girls."

- (f) Show a penny and a dime.
"We shall place a penny for each boy in the class in one row."
"We shall place a dime for each girl in the class in another row."

- (g) Show the following graph.
"This is a **CONCRETE GRAPH**, which displays the information about how many boys and girls are in a class."

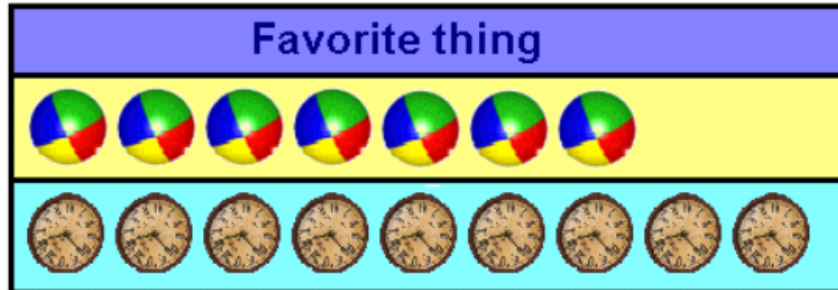


- (h) Have the student show the following information using simple graphs or concrete materials.
- (1) 4 children like cats and 2 children like dogs
 - (2) In a class there are 8 boys and 10 girls
 - (3) 5 students chose pens and 7 students chose pencils
- (i) Continue with this lesson until the student can comfortably display answers on a graph or chart with confidence.
- (j) Repeat the diagnostic test.

☺ Diagnostic K7.2 Interpret Data from Graphs

To pass, the student should be able to interpret data exhibited in concrete or pictorial graphs with confidence.

"Interpret the data in the picture graph below."



If the diagnostic fails, then do the Lesson & Exercise.

Lesson & Exercise

In this lesson the student interprets data exhibited in concrete or pictorial graphs.

(a) Start the lesson.

"In this lesson we are going to interpret data from a graph."

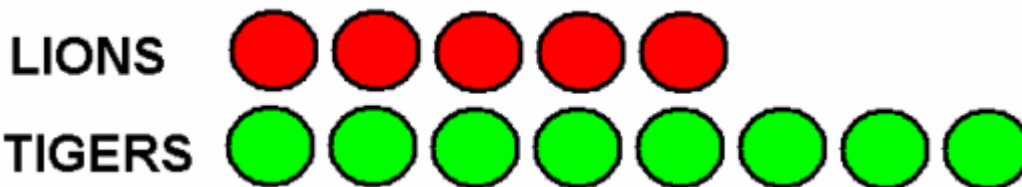


(b) Show the picture above and explain.

"There are two choices for favorite things - a ball and a clock.

"7 people chose a ball as their favorite thing. (Count the balls)

"9 people chose a clock as their favorite thing." (Count the clocks)



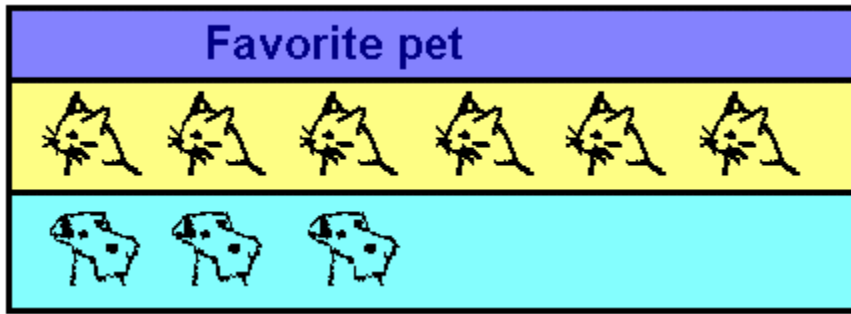
(c) Show the concrete graph above and explain.

"This graph provides information about two categories of animals - lions and tigers."

"There are 5 lions." (Count the lions)

"There are 8 tigers." (Count the tigers)

(d) Have the student interpret the information from the following picture graph.



(e) Have the student interpret the information from the following concrete graph.



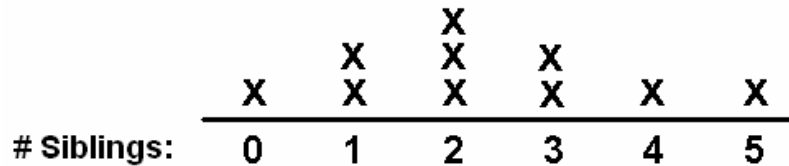
(f) Continue with this lesson until the student can interpret data from graph comfortably with confidence.

(g) Repeat the diagnostic test.

☺ Diagnostic K7.3 Show Range and Mode

To pass, the student should be able to use concrete materials, pictures, or graphs to show range and mode correctly and with confidence.

"The following graph displays the number of siblings, for persons marked as X. Explain the RANGE and MODE of siblings among this group of people."



If the diagnostic fails, then do the Lesson & Exercise.

Lesson & Exercise

In this lesson the student uses concrete materials, pictures, or graphs to show range and mode (for example, on a human, block, or picture graph showing number of brother and sisters, range is from zero to highest number of siblings; mode is number of siblings most common in class).

(a) Start the lesson.

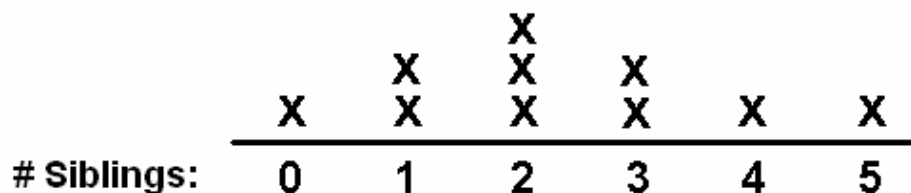
"In this lesson we are going to use pictures, or graphs to show range and mode."

(b) Provide the information to display.

"Suppose we ask the students how many siblings they have, and we collect the following information.

- (a) 1 person has no siblings.
- (b) 2 persons have 1 sibling
- (c) 3 persons have 2 siblings
- (d) 2 persons have 3 sibling3
- (e) 1 persons have 4 siblings
- (f) 1 persons have 5 siblings

"We note that the number of siblings range from 0 to 5. So we write down these numbers on the floor under a line. We then ask the students to stand in front of the number, which is equal to the number of siblings they have.



"Thus, we have the graph drawn above. Each X in this graph is a person with as many siblings as the number for that column."

(c) Explain the RANGE.

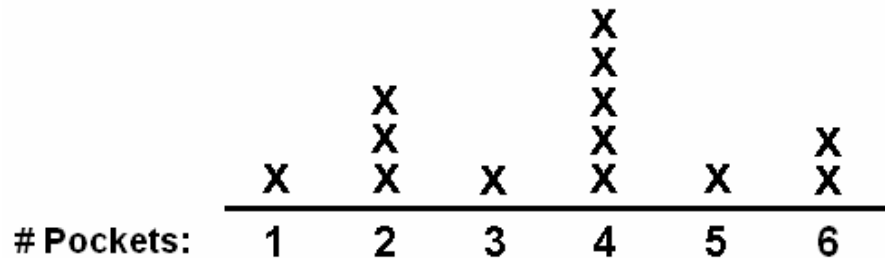
"The lowest number of siblings is 0. The highest number of siblings is 5. The difference between these two numbers ($5 - 0 = 5$) is called the RANGE.

(d) Explain the MODE.

"The number 2 has the longest column. This means that having 2 siblings is the most common occurrence in this group. This is the most common MODE. Therefore, the MODE is 2."

(e) Have the student find the range and mode of the pockets from the responses in the following exercise.

Suppose you collected some information in response to the question, "How many pockets do you have in your clothes." The following graph displays this information.



(f) Have the student do the following exercise.

(1) Ask at least 10 people, "How many pockets do you have in your clothes."

(2) Display that information on a graph as explained in this lesson.

(3) Determine the range and mode of the pockets from your graph.

(g) Continue with this lesson until the student can show range and mode correctly and with confidence.

(h) Repeat the diagnostic test.

☺ Diagnostic K7.4 Make Generalizations from Data

To pass, the student should be able to collect, display data, and make generalizations.

“Display the following data on a Bar Graph: 4 rooms have 6 windows.”

“From this graph predict: 8 rooms will have ____ windows.”

If the diagnostic fails, then do the Lesson & Exercise.

Lesson & Exercise

In this lesson the student collects, displays data, and makes generalizations (for example, determines number of pockets on 5 children; predicts how many 10 students or the whole class will have).

(a) Start the lesson.

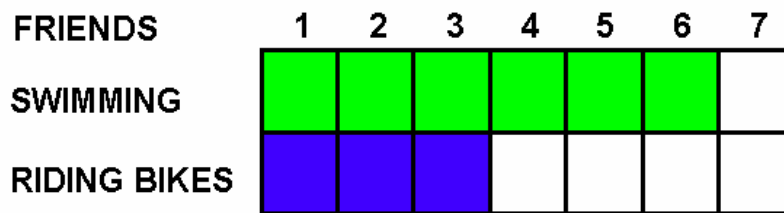
“In this lesson we are going to collect some data, display it on a graph and then draw some conclusions.”

(b) Show how to collect data.

“Let’s ask some people in the class if they like SWIMMING or RIDING BIKES.”

(c) Show how to display collected data.

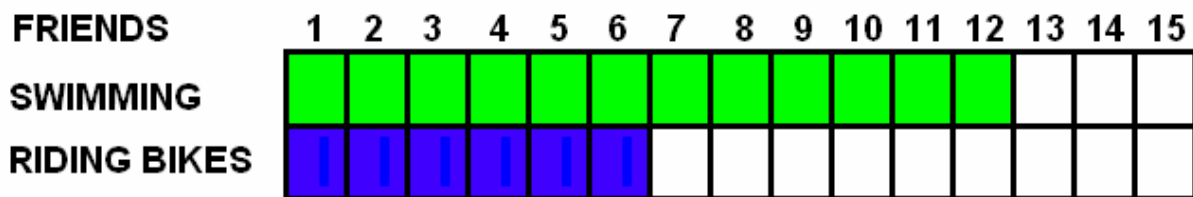
“Suppose 6 of them chose swimming and 3 of them chose riding bikes. On a bar graph we fill 6 squares for SWIMMING, and 3 squares for RIDING BIKES.



“We note that twice as many people like swimming as riding bikes.”

(d) Show how to generalize data.

“We may predict from this data by painting as many squares again. Let’s paint 6 more squares for SWIMMING, and 3 more squares for RIDING BIKES.



“We note that if 12 people chose swimming then 6 people would chose bike riding.”

(e) Have the student follow the procedure of this lesson to find

(1) If 2 dogs have 4 ears then 4 dogs will have ____ ears.

(2) If 3 cats have 6 eyes then 6 cats will have ____ eyes.

(3) If 5 students have 10 pockets then 10 students will have ____ pockets.

(f) Continue with this lesson until the student can comfortably make generalizations with data.

(g) Repeat the diagnostic test.

☺ Diagnostic K7.5 Know Likelihood of Given Situations

To pass, the student should be able to describe the likelihood of a given situation, correctly and with confidence.

"How likely are the following events?"

- (a) You will have school tomorrow.
- (b) A lion will visit you today.
- (c) It will rain in the evening.

If the diagnostic fails, then do the Lesson & Exercise.

Lesson & Exercise

In this lesson the student learns about the likelihood of a given situation (for example, Could a lion come visit you? Will we have school tomorrow? Will it rain today?).

(a) Start the lesson.

"In this lesson we are going to look at the likelihood of something happening."

(b) Provide some examples.

"It is very likely that you will have breakfast tomorrow morning. This is very likely because you know that you have breakfast every morning.

"It is not likely that an alien will be eating breakfast with you. This is not likely because you know that an alien has never eaten breakfast with you.

"It is somewhat likely that you will eat pancakes in your breakfast. This is somewhat likely because you have at times eaten pancakes in your breakfast."

(c) Explain the idea of likelihood.

"The likelihood of an event depends on how often you have seen it occur in the past."

(d) Have the student answer the following with (i) very likely (ii) somewhat likely (iii) not likely:

- (1) You will go to the movies this evening.
- (2) It will be cold tomorrow.
- (3) Your favorite relative will visit you this weekend.
- (4) It will rain tomorrow.
- (5) You will sleep in your room tonight.

(e) Continue with this lesson until the student can describe the likelihood of a given situation, correctly and with confidence.

(f) Repeat the diagnostic test.

☺ Diagnostic K7.6 Participate in Activities Dependent upon Chance

To pass, the student should be able to participate in games or activities dependent upon chance, correctly and with confidence.

"Flip a coin 40 times."

"Show the number of HEAD and TAIL on a bar graph."

If the diagnostic fails, then do the Lesson & Exercise.

Lesson & Exercise

In this lesson the student participates in games or activities dependent upon chance (for example, using spinners or number cubes).

(a) Start the lesson.

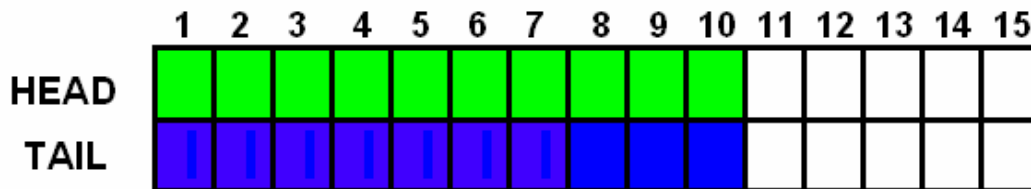
"In this lesson we are going to look at how likely it is to get a head or a tail when you flip a coin."

(b) Explain the experiment.

"We are going to flip a coin 20 times. We shall record the number of times we get a head or a tail."

(c) Flip the coin 20 times.

"Let's plot the results on a bar graph. Your graph may appear somewhat like the one below."



"This graph shows that it is equally likely to get a head or a tail. That is to say, half of the time you will get a head. The other half of the time you will get a tail."

(d) Help the student flip a coin 50 times and graph the results on a bar graph. Is the number nearly the same for head and tail?

(e) Have the student do the following exercise.

Place an equal number of marbles of two different colors in a bag. Without looking, pick a marble out of the bag. Note its color, and then put it back and shake the bag. Repeat this 20 times. Graph how many times each color was picked.

(4) Continue with this lesson until the student can comfortably participate in games or activities dependent upon chance.

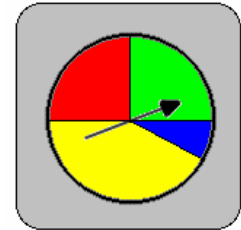
(5) Repeat the diagnostic test.

☺ Diagnostic K7.7 Grade Likelihood of Events

To pass, the student should be able to explore if a given event is more likely, equally likely, or less likely to occur with confidence.

"For the spinner on the right, which of the two outcomes is more likely?"

- (a) Yellow or blue
- (b) Red or green
- (c) Red or yellow
- (d) Green or blue



If the diagnostic fails, then do the Lesson & Exercise.

Lesson & Exercise

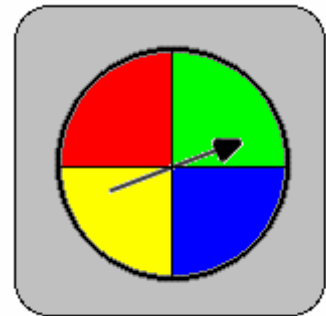
In this lesson the student further explores if a given event is more likely, equally likely, or less likely to occur (for example, chicken nuggets or pizza for lunch in the cafeteria).

- (a) Start the lesson.

"In this lesson we are going to compare the likelihood among several possible outcomes."

- (b) Introduce the spinner.

"Let's take a spinner as shown in this picture. This spinner is mounted on a circle. The circle is divided in four equal parts. These parts are colored red, green, blue, and yellow."



- (c) Introduce the outcomes.

"When you spin the needle on the spinner it must stop at one of the colors. Therefore, there are four possible outcomes:

- (1) The spinner may stop on red.
- (2) The spinner may stop on green.
- (3) The spinner may stop on blue.
- (4) The spinner may stop on yellow."

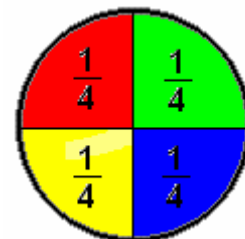
- (d) Explain the relative likelihood of these outcomes.

"These four outcomes are equally likely because they cover equal portions of the circle."

- (e) Explain the experiment.

"Let's spin the spinner 40 times. Since the four outcomes are equally likely, we expect the spinner to stop:

- (1) Ten times on red.
- (2) Ten times on green.
- (3) Ten times on blue.
- (4) Ten times on yellow."

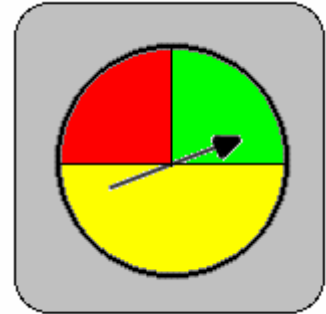


- (f) Conduct the experiment.

“As expected, the needle stops on each color close to one quarter of total times. We may show this by a circle graph as above.”

- (g) Conduct another experiment.

“Let’s take another spinner as shown on the right. Here the yellow color covers half of the circle. The other half of the circle is divided equally into red and green parts.”



- (h) Explain the outcomes.

“The possible outcomes are red, green, and yellow.”

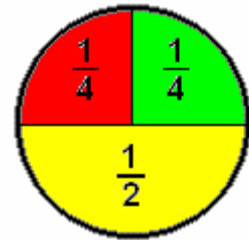
- (i) Explain the relative likelihood of these outcomes.

“YELLOW covers half of the circle. Therefore, the spinner is likely to stop on yellow half of the time. RED and GREEN cover quarter of the circle each. Therefore, the spinner is likely to stop on red and green quarter of the time each.”

- (j) Explain the experiment.

“Let’s spin the spinner 40 times. We expect the spinner to stop:

- (1) Ten times on red.**
- (2) Ten times on green.**
- (3) Twenty times on yellow.”**



- (k) Conduct the experiment.

“As expected, the needle stops on red and green about one quarter of the times. But it stops on yellow about half of the times.”

- (l) Help the student do the following exercise.

- (1) Repeat the first experiment with 100 spins. Check if all outcomes turn out to be equally likely.**
- (2) Repeat the second experiment with 100 spins. Check if the outcome of YELLOW is twice as likely as the other two outcomes.**
- (3) If a spinner were all yellow, how likely would it be for needle to land on yellow?**

- (m) Have the student do the following exercise.

- (1) Mary has 10 candies in her pocket. 8 are yellow. 2 are blue. If Mary pulls one out of her pocket, what color it is more likely to be: YELLOW or BLUE?**

- (n) Continue with this lesson until the student can comfortably grade the likelihood of events with confidence.

- (o) Repeat the diagnostic test.

☺ Diagnostic K7.8 Answer Simple Survey Questions

To pass, the student should be able to determine through class discussions questions for a simple two-choice survey so that the collected information will answer the questions.

“Determine the best question to find out the type of animal most people would like to keep as a pet.”

If the diagnostic fails, then do the Lesson & Exercise.

Lesson & Exercise

In this lesson the student determines through class discussions questions for a simple two-choice survey so that the collected information will answer the questions.

- (a) Start the lesson.
“In this lesson we are going to discuss questions for a two-choice survey.”
- (b) Describe the survey.
“Suppose we want to know if more people have cats as pets than dogs or the other way around. What would be the best question to find that out?”
- (c) Discuss the question while providing hints.
“We should simply find out if a person has a cat or a dog. Once we have a number of answers we can total them up.”
- (d) Formulate the question.
“Let’s use the question: Do you have a cat, or a dog?”
- (e) Have the student determine questions to find out the answers to the following:
 - (1) Which juice is more popular, orange or apple?**
 - (2) Which drink is more popular, Coca Cola or Pepsi?**
 - (3) On weekends, do people sleep in late or get up early?**
- (f) Continue with this lesson until the student can comfortably create survey questions with confidence.
- (g) Repeat the diagnostic test.

☺ Diagnostic K7.9 Answer Simple Class Question

To pass, the student should be able to display the answer to a simple class question with two categories using concrete materials, a pictograph, or chart, with confidence.

"Graphically display the answer to the following question."

DO YOU LIKE WATER OR JUICE?

If the diagnostic fails, then do the Lesson & Exercise.

Lesson & Exercise

In this lesson the student displays the answer to a simple class question with two categories using concrete materials, a pictograph, or chart (for example, hot or cold; wings or no wings).

(a) Start the lesson.

"In this lesson we are going to display the answer to a simple class question with two categories."

(b) Describe the question.

"The question is: TO TRAVEL FROM WASHINGTON TO NEW YORK, WOULD YOU CHOOSE A PLANE OR A TRAIN?"

(c) Distribute a blank graph to each student.

"We shall start with a blank graph with two rows. We shall mark the rows as PLANE and TRAIN."

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PLANE															
TRAIN															

(d) Describe the procedure.

"We shall fill a square for each answer. If the answer is PLANE we fill a square in the first row. If the answer is TRAIN we shall fill a square in the second row."

(e) State the question to each student one by one, and mark the answers on the graph accordingly.

"Let's say we end up with the following graph."

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PLANE															
TRAIN															

- (f) Interpret the graph.
"We may read this graph as: 7 people will prefer to travel by PLANE. 13 people will prefer to travel by TRAIN."
- (g) Have the student ask the following questions and show the answers on a graph:
- (1) What do you prefer at breakfast, cereal or eggs?**
 - (2) Do you like to hear a story at bedtime – Yes, No?**
 - (3) Pick a fruit – Apple or Orange.**
- (h) Continue with this lesson until the student can comfortably displays the answer to a simple class question with confidence.
- (i) Repeat the diagnostic test.

SUMMARY

This is the last of the seven levels of the Troubleshooting Guide for KINDERGARTEN MATH. The Troubleshooting Guide for Kindergarten introduces the concept of UNIT, and explores ways to measure length, weight, capacity and time. It further develops the concept of counting into the concepts of addition and subtraction.

The Kindergarten troubleshooting guide is divided into the following levels:

(1) ORIENTATION & SPATIAL SENSE

Orientation and Spatial Sense forms the foundation of the subject of GEOMETRY. It introduces the elements of space and how they relate to us.

(2) NUMBERS & PLACE VALUES

Numbers and Place Values form the foundation of the subject of ARITHMETIC. It introduces a system of whole numbers to represent quantities in a simple manner.

(3) UNITS & FRACTIONS

Units & Fractions addresses ways to represent quantities, which cannot be represented by whole numbers.

(4) COUNTING & MEASUREMENTS

Counting & Measurements provides ways to determine the various magnitudes. It helps to bring familiarization with the use of numbers.

(5) NUMBERS & OPERATIONS

Numbers & Operations introduces the basic operations with numbers and how such operations may be executed with skill.

(6) PATTERNS & RELATIONAL SENSE

Patterns and Relational Sense forms the foundation of the subject of ALGEBRA. It is a study of patterns underlying numbers, and quantitative relationships.

(7) DATA ANALYSIS & PROBABILITY

Data Analysis & Probability shows how to display quantitative comparisons graphically. It introduces the estimation of likelihood.

Though these lessons are designed for the kindergarten level, these diagnostic actions may be used for students at higher grades to help discover and resolve missing basics.

GLOSSARY

[For additional words refer to the glossary at the end of Level K1.]

Analysis **Analysis** is to examine something by breaking it down into parts that make it up.

Concrete Graph A **concrete graph** displays information using objects. Here is a display of what a class consists of.



Data **Data** refers to items of information.

Picture Graph A **picture graph** displays information using pictures. Here is a display of responses to the question, "Which is your favorite pet?"



Probability **Probability** is the likelihood or chance of something happening.

Range The **range** of a graph is the difference between the highest score and the lowest score in that graph.

Mode The **mode** is the score, which has the most occurrences in a set of scores.