Maps, Charts, & Graphs
Program 5 Guide

The *Go Figure? Interactive Multimedia Kit* may be used in a classroom or intervention setting. Presented in a fun and creative way, each program on the *Go Figure?* DVD can be used as an introduction to or a review of basic mathematics concepts. The accompanying CD-ROM edu-game was designed for use by students on an individual basis. The object of the edu-game is to solve a mystery. In order to do this, the student must solve mathematics problems in the specific content areas presented by the DVD dramatic video series. Consequently, programs on the DVD are used to generate interest in and enthusiasm for learning mathematics concepts, while the CD-ROM edu-game allows students to practice the concepts in a challenging game format.

The three main characters in each DVD video program – the mysterious Pythagleo, plus two students named Carter and Chris who are trying to solve the mystery of Etna High School – discuss the targeted math concepts.

Chris, and to a lesser extent, Carter, verbalizes what each is thinking as they work through problems associated with the math concepts. The DVD programs assume that, like Chris and Carter, your students have already been introduced to the math concepts presented in the episode. The dialog may be too quick for some students. Every step that some of your students will need to solve similar problems on their own may not be mentioned in the programs. Therefore, pausing the DVD to review or present additional information will help adapt the learning situation to the needs of your students. See additional materials about teaching with videos and differentiated instruction in the Introduction of the Teacher Resources Guide.

Ohio Mathematics Content Standards and Benchmarks

Data Analysis and Probability

A. Read, create and use line graphs, histograms, circle graphs, box-and-whisker plots, stem-and-leaf plots, and other representations when appropriate.
B. Interpret data by looking for patterns and relationships, draw and justify conclusions, and answer related questions.
D. Compare increasingly complex displays of data for a specific purpose or need.
E. Collect, organize, display, and interpret data for a specific purpose or need.

Math Content

- How to use coordinates to find locations and read a conversion scale on a map
- Chart/table – lists of data
- How to read and interpret
    - Circle Graph – defined and how to use
    - Bar Graph – defined and how to use
    - Line Graph – defined and how to use
    - Pictograph – defined and how to use

Additional Math Content

- Frequency Table
- Histogram
- Stem-and-Leaf Plot
- Box-and-Whisker Plot (Box Plot)

Episode Note

- Chris and Carter find a map with a note saying "The room located at E3 will be the containment room." Why would a school need a containment room? What does it have to do with the missing students? They search for the room and find 1966 newspaper stories about increased "sightings" and dropping water levels at the nearby reservoir. Pythagleo shares other statistics about Etna High in 1966.

Teacher Notes

- See the chart, graph, table, and plot examples included with this guide.
  - Most were shown in the Program 5 video "Maps, Charts, and Graphs".
  - The following are not in the video but are based on information in the video: frequency table, histogram, stem-and-leaf plot, and box plot (box-and-whisker plot).
- See background on frequency tables, histograms, stem-and-leaf plots and box plots below.

Frequency Table

Carl's 2nd Term Quiz Score Frequency Table													
54	55	56	58	60	61	65	66	74	75	77	80	84	85
1	2	1	1	1	1	1	1	2	4	1	1	1	1

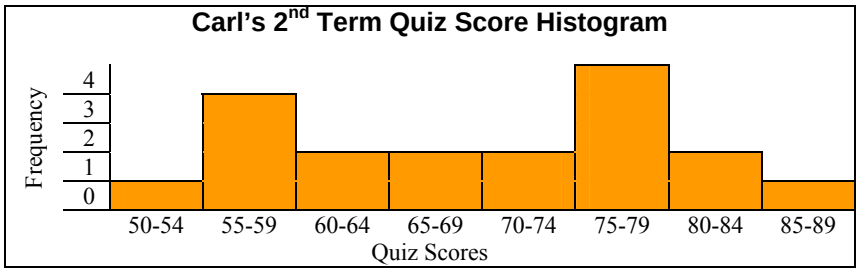
A frequency table is a record of how often each value (or set of values) of the variable in question occurs. It may be enhanced by the addition of percentages that fall into each category.

The frequency table in the example uses the data set {55, 56, 85, 65, 58, 77, 75, 74, 66, 61, 60, 54, 55, 74, 75, 80, 75, 84, 75}.

The data set was ordered {54, 55, 55, 56, 58, 60, 61, 65, 66, 74, 74, 75, 75, 75, 75, 77, 80, 84, 85}. The frequency of each different data item is counted and entered into a table. The table may be horizontal or vertical.

Histogram

A histogram is a frequency graph that looks similar to a bar graph without spaces between the bars. Histogram creators simplify the data by grouping it into equal spaced intervals. The quantity of the intervals is important. A histogram with too few or too many interval bars may distort the data or make the graph difficult to read.



A histogram uses the frequency of data to paint a visual representation of that data. Histograms will make it easy to see where the majority of values fall in a measurement scale, and how much variation there is.

The histogram in the example uses the data from the Frequency Table example above. The quiz scores were grouped by intervals of 5 starting at 50 to create eight bars.

Stem-and-Leaf Plot

Carl's 2nd Term Quiz Scores

5	4 5 5 6 8
6	0 1 5 6
7	4 4 5 5 5 5 7
8	0 4 5

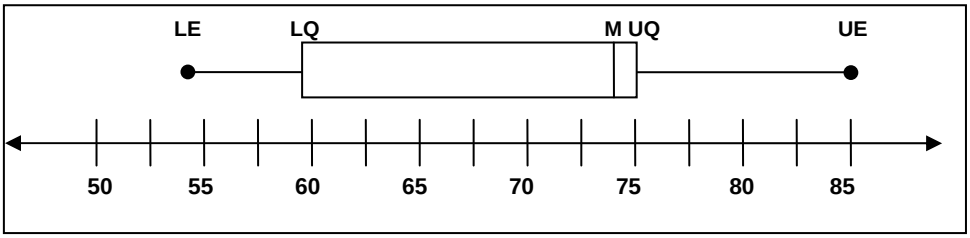
Key: 5|4 means 54

The stem-and-leaf plot arranges numerical data in an easy to see and use ordered list. Most plots are divided with the last digit (ones) as the leaf and the first digits (thousands, hundreds, tens) as the stem. 56 would be split 5|6 and 782 as 78|2. A title and a key should be included.

There can be exceptions to the way numbers are divided to create stem-and-leaf plots. One may wish to limit the number of stems to a reasonable amount or use the data in a specific manner. For example, 345.075 might be split 345|075 or rounded to 345 and split 34|5.

The stem-and-leaf plot in the example uses the data set {55, 56, 85, 65, 58, 77, 75, 74, 66, 61, 60, 54, 55, 74, 75, 80, 75, 84, 75}.

Box-and-Whisker Plot or Box Plot



Use a box-and-whisker plot to show a summary of a data set. When you want to compare two or more sets of data, box-and-whisker plots can be used to quickly show the differences between them.

The box-and-whisker plot uses a number line and five numbers from the data set to paint a visual picture. The required data is:

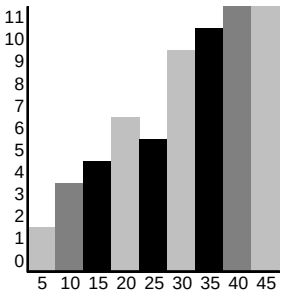
1. Lower Extreme (LE) – The smallest number from the data set. Use it as the left whisker's end point.
2. Upper Extreme (UE) – The largest number. Use it as the right whisker's end point.
3. Median (M) – The number in the exact middle, when the data is arranged in an ordered list. It marks the location of the vertical line within the box. *(Average the middle two numbers if there is an even number of values in the data set).*
4. Lower Quartile (LQ) – Exclude the median. The number that is the exact middle number of the values to the left of the median. It marks the location of the left edge of the box. *(Average the middle two numbers in this part of the data set if there is an even number of values).*
5. Upper Quartile (UQ) – Exclude the median. The number that is the middle number of the values to the right of the median. It marks the location of the right side of the box. *(Average the middle two numbers in this part of the data set if there is an even number of values).*

The box-and-whisker plot in the example uses the data set: {55, 56, 85, 65, 58, 77, 75, 74, 66, 61, 60, 54, 55, 74, 75, 80, 75, 84, 75}. The stem-and-leaf plot example at the top of the page may be used as an ordered list of the data. The summary data is:

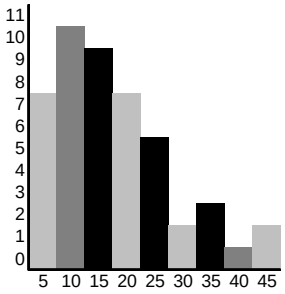
- Lower Extreme – 54
- Upper Extreme – 85
- Upper Quartile – 75
- Lower Quartile – 58
- Median – 74

Go Figure? Charts and Graphs Glossary

Term	Definition
categorical data	The values or observations belonging to a data set can be sorted according to category. For example, color: red, yellow, blue; or dog breeds: Collie, German Shepherd, Norwegian Elkhound.
continuous data	Data that has meaning at all points between the numbers given For example: age – a data set may give the ages 15, 16, 17, 18; but a living thing could have an age of 18 years 8 months, 18.2 or 18 –and-a-half.
discrete data	Data that does not have meaning between all points of the given numbers For example: multimedia sales – one does not sell a portion of a CD, half of a DVD, or 0.25 of an iTune download.
level of symmetry	The degree to which a set of values or observations has symmetry.
skewness	Skewness is when a set of values are not distributed in the same way above and below the middle of the sample. Values on one side of the distribution tend to be further from the middle than values on the other side.



Skew Left
This histogram has a negative skew. The data has a **"**tail" to the left – the negative side.

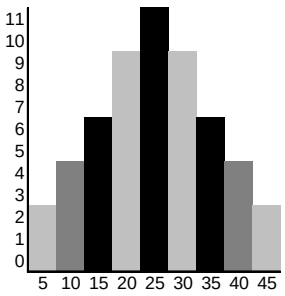


Skew Right
This histogram has a positive skew. The data has a "tail" to the right – the positive side.

symmetry When a set of values or observations is distributed in the same way above and below the middle of a sample, it is said to be symmetrical.

Symmetrical data sets are easily interpreted.

In a perfectly symmetrical distribution of the data, the mean, median and mode have the same value. Half of all measurements are greater than the mean, while half are less than the mean.



Symmetrical Histogram

Term	Definition
outlier	Any value that is markedly smaller or larger than other values For example, in the data set {3, 5, 4, 4, 6, 2, 25, 5, 6, 2} the value of 25 is an outlier. An outlier might be the result of an error in measurement. If it is an error it will distort the interpretation of the data. Outliers should not be removed unless there is a good reason to delete them from the data. If an outlier is a genuine result, it is important because it might indicate an extreme of behavior of the process under study. For this reason, all outliers must be examined.
quartiles	Quartiles are values that are given a fraction of the way through a data set which has been arranged in order from least to greatest. • Median: Half way through the ordered set. 50 % of the data is above the point and 50% is below it. It is also known as the 50th percentile point. • Lower Quartile: One fourth of the way through the ordered set. 25% of the data is below the point and 75% of the data is above it. It is also known as the 25th percentile point. • Upper Quartile: Three fourths of the way through the values. 75% of the data is below the point and 25% of the data is above it. It is also known as the 75th percentile point.

Maps, Charts, & Graphs
Worksheet 1

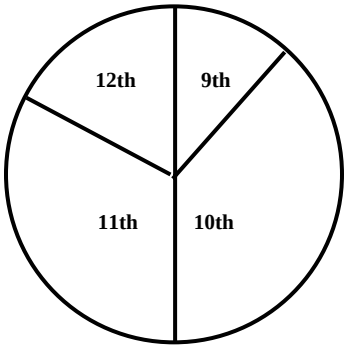
Choice *E*, in multiple-choice questions, is always: *I request help from the teacher*.

You may mark E in addition to one other choice if you think that you have the right answer to the question but you do not feel that you have a complete understanding of the problem.

Your teacher will decide whether to use the two-point or four-point scoring rubric for problems that use numbers, pictures, or words to justify/explain your answer(s). You may request help for these questions, too. Write the word "teacher" by your answer(s).

1. The circle graph below represents the number of students at Western High School in Enigma, Ohio. Western replaced Etna High when it was abandoned. The total school population of Western High School is 1,000. Which statement is true?

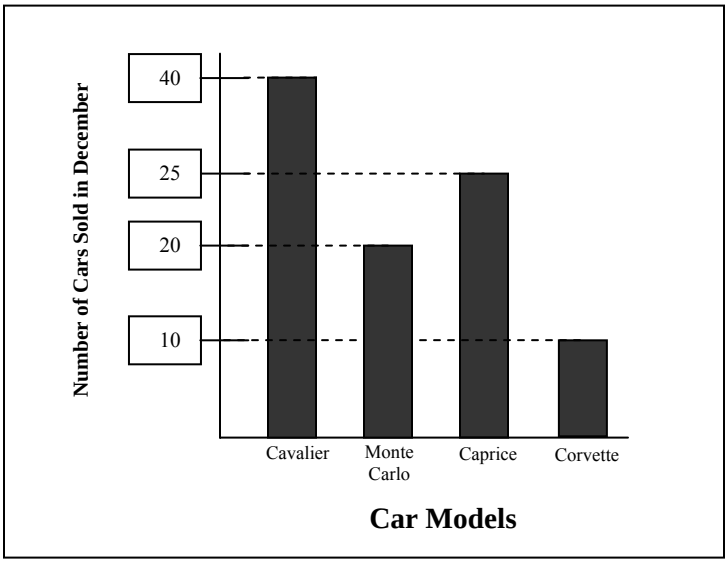
    A. There are more than 250 9th graders.
    B. There are more than 510 10th graders.
    C. There are more than 250 10th graders.
    D. There are less than 200 11th graders.
    E. Teacher



2. Using the graph in Exercise 1, again, which statement is true?

    A. Number of 9th graders > number of 10th graders.
    B. Number of 9th graders + number on 10th graders < number of 11th graders.
    C. Number of 12th graders > number of 10th graders.
    D. Number of 10th graders > number of 9th graders.
    E. Teacher

Use the bar graph and the information below for exercises #3 - #6.



The Grand River Chevrolet Dealership showed its December sales in the given bar graph.

- The average Cavalier sells for $17,000.
- The average Monte Carlo sells for $22,000.
- The average Caprice sells for $26,000.
- The average Corvette sells for $35,000.

3. Using the average selling prices listed above, which statement is true?

   A. Monte Carlo sales were $90,000 more than the Corvette sales.
   B. Corvette sales were $130,000 more than the Monte Carlo Sales.
   C. Monte Carlo sales were $13,000 more than Corvette sales.
   D. The sales of the Monte Carlos and Corvettes were the same.
   E. Teacher.

4. How many cars were sold at the Grand River Chevrolet Dealership during the month of December?

   A. 90 B. 95 C. 100 D. 85 E. Teacher

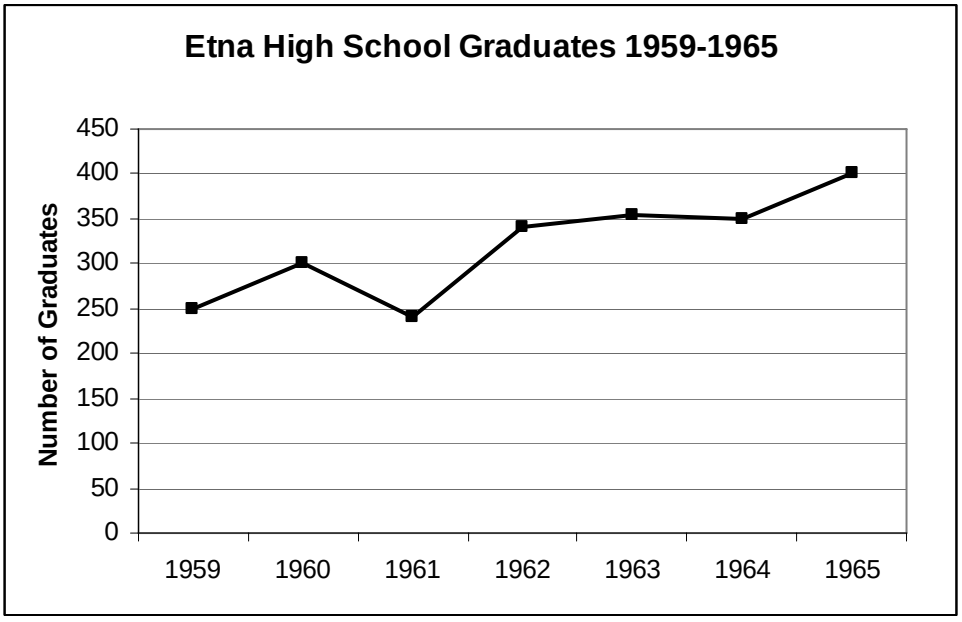
5. Which statement is false?

   A. There were twice as any Monte Carlos sold than Corvettes during the month of December.
   B. There were four times as many Cavaliers sold than Corvettes during the month of December.
   C. There were twice as many Cavaliers sold than Monte Carlos during the month of December.
   D. There were three times as many Caprices sold than Corvettes.
   E. Teacher

6. What was the difference between the number of Corvettes and the number of Caprices sold in December?

   A. 20 B. 15 C. 30 D. 5 E. Teacher

Use the following graph for exercises #7 - #10.



7. Between which two years did the number of graduates decrease?

   A. 1961-1962 B. 1960-1961 C. 1962-1963 D. 1964-1965 E. Teacher

8. Estimate the number of graduates between and including 1959 and 1965.

   A. 3,000 B. 2,500 C. 2,200 D. 1,000 E. Teacher

9. Between which two years was the change the least?

   A. 1963-1964 B. 1962-1963 C. 1959-1960 D. 1960-1961 E. Teacher

10. Between which two years was there the biggest change?

    A. 1959-1960 B. 1960-1961 C. 1959-1960 D. 1961-1962 E. Teacher

Maps, Charts, & Graphs
Worksheet 2

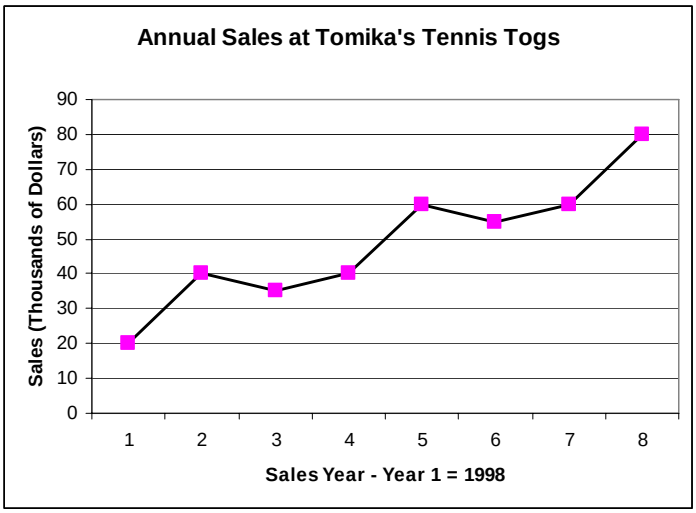
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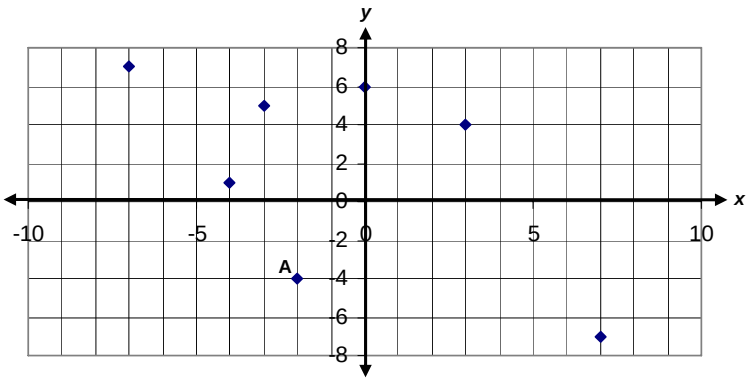
1. The graph shows annual sales at Tomika's Tennis Togs during its first eight years of business. According to the graph, which prediction is reasonable for the annual sales in Year 9?

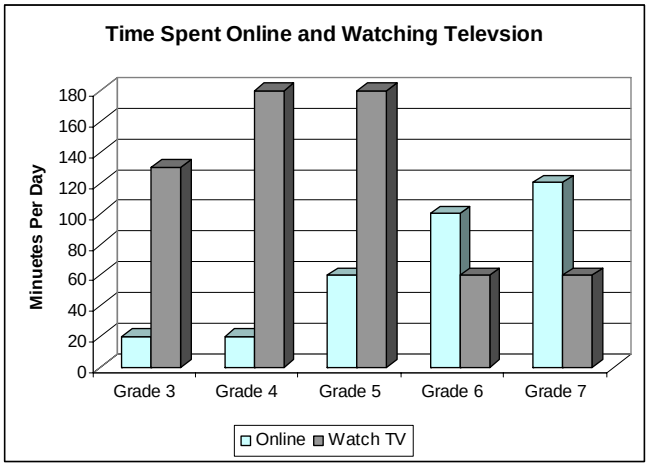
   A. $ 75,000
   B. $ 80,000
   C. $105,000
   D. $120,000
   E. Teacher



2. Point A is shown on the coordinate grid. Which ordered pair represents point A?

   A. (2, 4)
   B. (– 2, 4)
   C. (– 4, – 2)
   D. (– 2, – 4)
   E. Teacher





3. The double bar graph shows the average amount of time students in five different grades spend watching television and using the Internet online each night. Which grades spend the most time watching television shows each night?

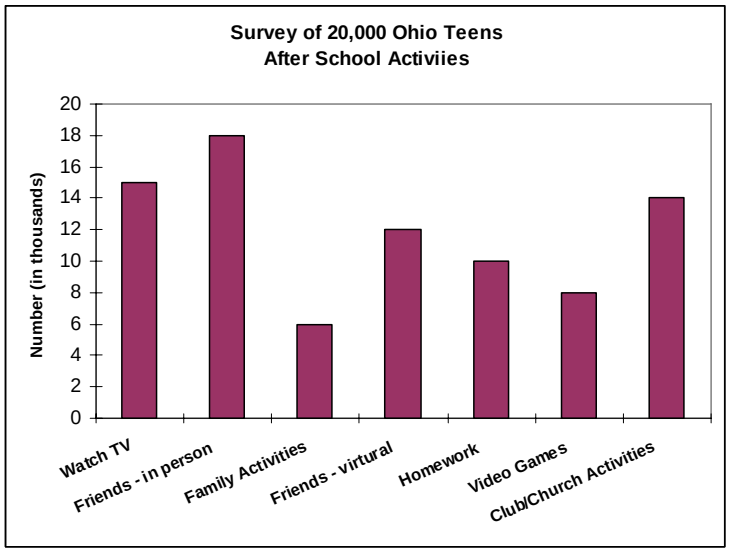
   A. Grade 3 and 4
   B. Grade 4 and 5
   C. Grade 5 and 6
   D. Grade 6 and 7
   E. Teacher

4. Chris decided to rate the performers on his fifteen favorite audio CDs. He used a scale of 0 to 100 with 0 as the poorest possible rating. His ratings for 15 performers are shown in the table. Create a histogram with five intervals that represent Chris's data. Include a title and labels.

Performer Ratings	78	80	95	98	70	63	90	51	68	89	91	77	82	59	86

5. A newspaper surveyed 20,000 Ohio teens to learn what kinds of activities they were doing on week-days after school. The graph shows the results. According to the results in the graph, which statement is NOT true?
   Note: this data is fictional.

   A. More than half of the surveyed teens play video games in the evenings.
   B. Teens choose more than one activity in the evenings.
   C. About three quarters of the surveyed teens watch television in the evening.
   D. More teens choose to interact with their friends than watch TV.
   E. Teacher



6. The scale for a map of Ohio (not shown) is 1 inch = 40 miles. If Enigma, Ohio is $3\frac{1}{4}$ inches from Dayton, Ohio, how many miles apart are the two cities?

   A. 120 mi. B. 160 mi. C. 130 mi. D. 400 mi E. Teacher

Use this chart for exercises #7 - #9.

Etna High Dropout Rates	
Year	**Dropout Rate**
1959	13 %
1960	11 %
1961	10 %
1962	9 %
1963	7 %
1964	4 %
1965	2 %

7. Between which years was there the most change?

A. 1964-1965 C. 1959-1960
B. 1963-1964 D. 1961-1962
E. Teacher

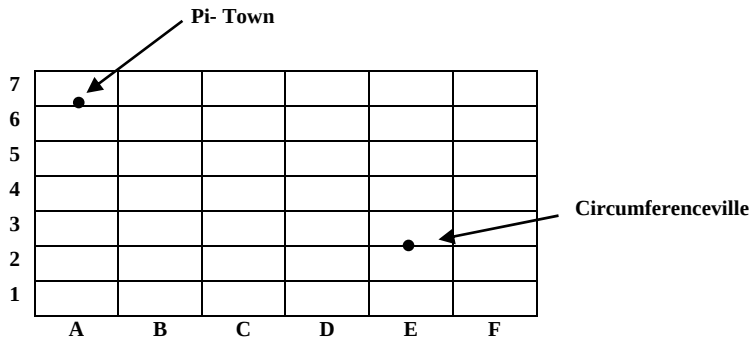
8. Between which of the following years was there the least change?

A. 1961-1962 C. 1959-1960
B. 1964-1965 D. 1962-1963
E. Teacher

9. Between 1959 and 1965 what was the change in the dropout rate? Use pictures, numbers, or words to justify your answer.

10. Use the grid below. Pi – Town is located in section…

A. E-2 B. A-7 C. A-5 D. E-5 E. Teacher



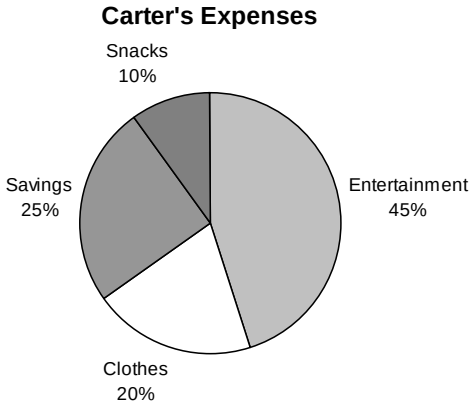
Maps, Charts, & Graphs
Worksheet 3

Choice *E*, in multiple-choice questions, is always: *I request help from the teacher*.

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Your teacher will decide whether to use the two-point or four-point scoring rubric for problems that use numbers, pictures, or words to justify/explain your answer(s). You may request help for these questions, too. Write the word "teacher" by your answer(s).

1. Carter earns $18 every week. The circle graph shows how Carter uses his money each week. How much money does Carter use for snacks and clothes each week? Use numbers, pictures, or words to explain your answer.



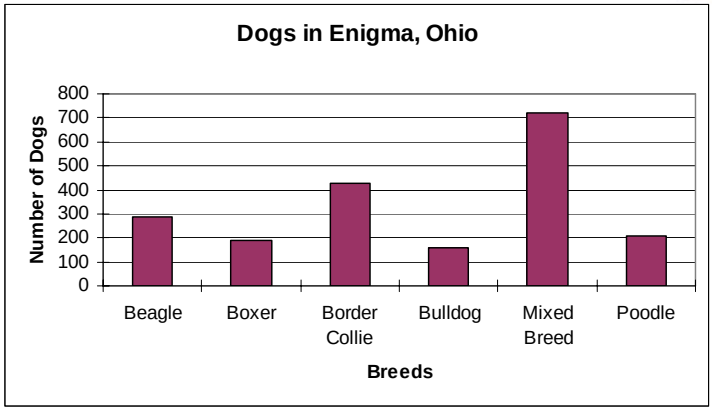
Population of Ohio Cities			
City	**2000 Population**	**2003 Population**	**%Change**
Akron	217,000	212,000	–2%
Cincinnati	364,000	317,000	–13%
Cleveland	506,000	461,000	–9%
Columbus	633,000	728,000	+15%
Toledo	314,000	309,000	–2%

2. The chart above shows changes in population in Ohio's five largest cities from 2000 to 2003. Based on the chart, which claim is a misuse of the data?

   A. Cincinnati lost 13% of its population between 2000 and 2003.
   B. Columbus gained people between 2000 and 2003.
   C. Akron and Toledo lost the same number of people between 2000 and 2003.
   D. As a general rule, Ohio's largest cities lost population between 2000 and 2003.
   E. Teacher

3. There are 2000 dogs in Enigma, Ohio. The graph shows the different kinds of dogs in town.

   a. Name a combination of 2 breeds of dog that make up half of the total dogs in town.
   b. Show or explain how you found your answer.



U. S. List of Endangered and Threatened Mammals

Mammal Species	No.	Mammal Species	No.
Bats	9	Rats & Mice	9
Cats	8	Seals & Sea Lions	4
Deer & Antelope	4	Whales	7
Fox	5		

4. Use the data in the table of endangered and threatened mammals to make a bar graph. Make sure your graph is accurate and complete.

1966 Burns' Reservoir Water Levels

Date	Depth in Feet	Date	Depth in Feet
4/10	65	5/8	27
4/17	53	5/15	22
4/24	50	5/22	11
5/1	41	5/29	7

1965 Burns' Reservoir Water Levels

Date	Depth in Feet	Date	Depth in Feet
4/10	87	5/8	86
4/17	90	5/15	83
4/24	87	5/22	81
5/1	88	5/29	79

5. Chris examined the water depths for Burns Reservoir in 1965 and 1966. She decided that the following information about the depths were most likely to have had some connection to the disappearance of the staff and students in 1966. Chris wants to display the information graphically.

   a. Plot or graph the data. Make sure your plot or graph is accurate and complete.
   b. Explain why the type of graph or plot you made is the best type for displaying the given data.

Maps, Charts, and Graphs

Answer Keys, Program 5: Worksheets 1 – 3

Each question on every worksheet offers the students the option of marking "Teacher" instead of or in conjunction with answering the question. The "Teacher" option is included to support student understanding and achievement. Students may have as much help and guidance as they need to understand concepts and master skills.

Instructors may decide whether to use the two or four point scoring rubric for constructed response problems (problems that use numbers, pictures, or words to justify/explain student answers). See the appendix for the complete rubrics.

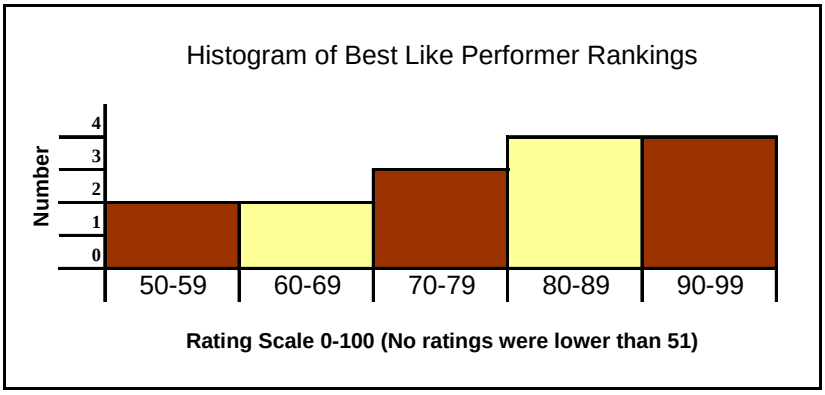
Two-Point Scoring Rubric	Four-Point Scoring Rubric
2 – Complete	4 – Complete
1 – Partial	3 – Clear
0 – Inadequate	2 – Partial
	1 – Minimal
	0 - Inadequate

Worksheet 1

1. C. There are more than 250 10th graders.
2. D. Number of 10th graders > number of 9th graders.
3. A. Monte Carlo sales were $90,000 more than the Corvette sales.
4. B. 95 cars
5. D. There were three times as many Caprices sold than Corvettes.
6. B. 15
7. B. 1960-1961
8. C. 2,200
9. A. 1963-1964
10. D. 1961-1962

Worksheet 2

1. A. $ 75,000
2. D. (– 2, – 4)
3. B. Grade 4 and 5
4. Graphs may vary slightly. *See sample histogram*. Answers should reflect the following: 1) The data set should be ordered 51, 59, 63, 68, 70, 77, 78, 80, 82, 86, 89 90, 91, 95 98. 2) The data set should be grouped into 5 logical intervals and the frequency for each interval counted. One possible way to group the data… 50s: 55 and 59 (2), 60s: 63 and 68 (2), 70s: 70, 77, 78 (3), 80s: 80, 82, 86, 89 (4), 90s: 90, 91, 95, 98 (4) 3) The histogram should be drawn without gaps between the bars. There should be a title and other labels to help explain the histogram.

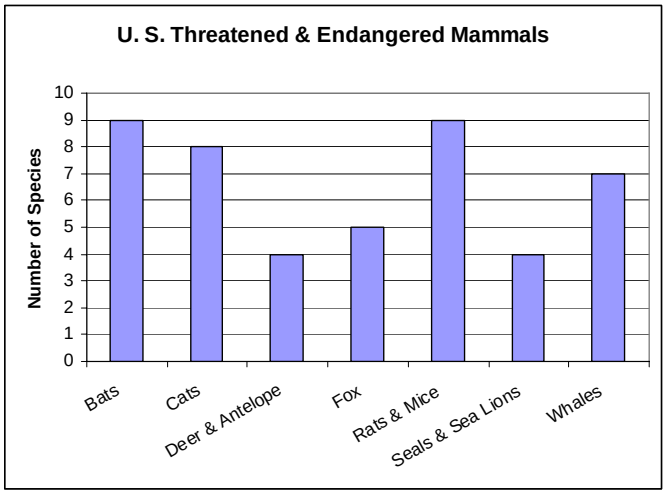


5. A. More than half of the surveyed teens play video games in the evenings.
6. C. 130 mi.

7. B. 1963-1964
8. A. 1961-1962
9. 11%, Answers should reflect the problem: 13 – 2 = 11.
10. B. A-7

Worksheet 3

1. $5.40. Answers should reflect the following problem: $18.00 x (.10 + .20) = $5.40.
2. C. Akron and Toledo lost the same number of people between 2000 and 2003.
3. Mixed Breed plus Beagles. Answers should reflect the following: 1) There are 2,000 dogs in town so half the dogs would be 1,000 dogs. 2) Only two dog breeds may be used. 3) There are just over 700 mixed breed dogs. 1,000 – 700+ = just under 300. 4) The breed closest in number to 300 is the Beagle.

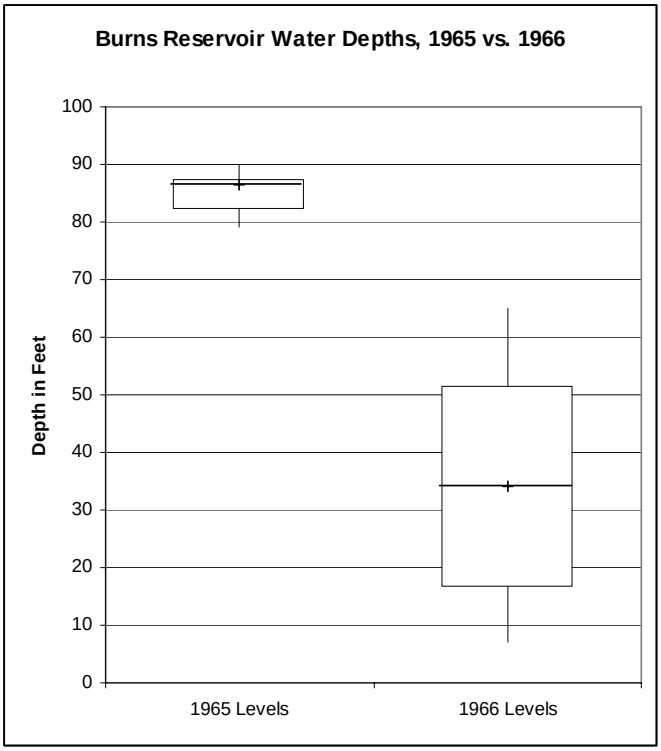


4. Answers may vary. Answers should reflect the following: 1) the graph should be divided into regular intervals that reflects the span of numbers in the data. 2) There should be a descriptive title and labels to help others understand the graph. 3) The data entered into the graph should accurately depict the data given in the table. Variables: Students may use intervals of 2 (0, 2, 4, 6…) or 3 (0, 3, 6, 9). The animals may be arranged in some other order.

5. Answers may vary. Most students will probably draw a double line graph, a double bar graph or box-and-whisker plots (box plots). Answers should reflect the following: 1) the graph(s) should be divided into regular intervals that reflects the span of numbers in the data. 2) There should be a descriptive title and labels to help others understand the graph. 3) The data entered into the graph should accurately depict the data given in the table. Variables: A student who chooses to draw box plots may wish to divide the data into two separate box plots rather than put them into the same graph. Box plots may be horizontal or vertical - as in the example.

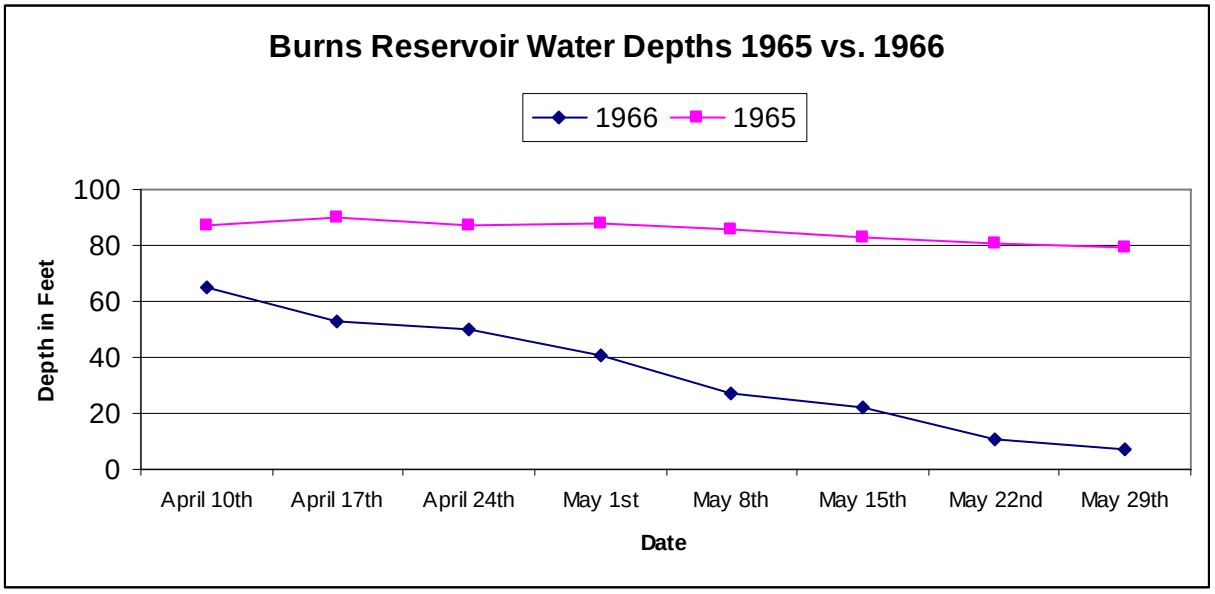
   Data summery numbers for 1965 and 1966.

	1965	1966
Median	86.5	34
Lower Quartile	82	16.5
Lower Extreme	79	7
Upper Extreme	90	65
Upper Quartile	87.5	51.5



See more sample graphs on the next page.

5. Double Line Graph Example



5. Double Bar Graph Example

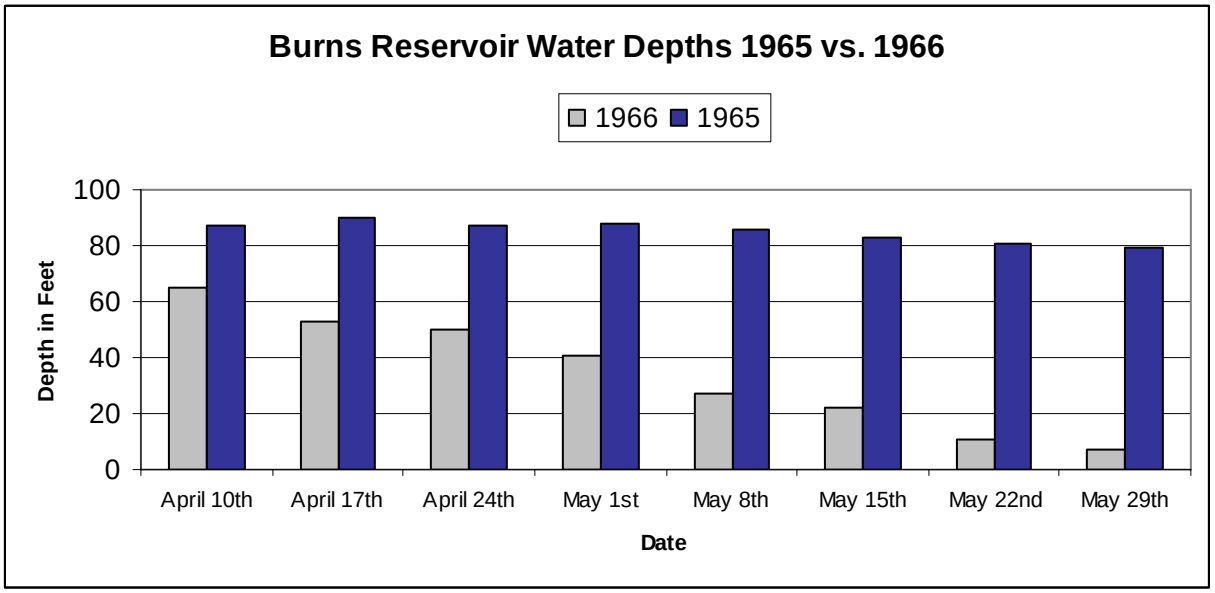


Chart:

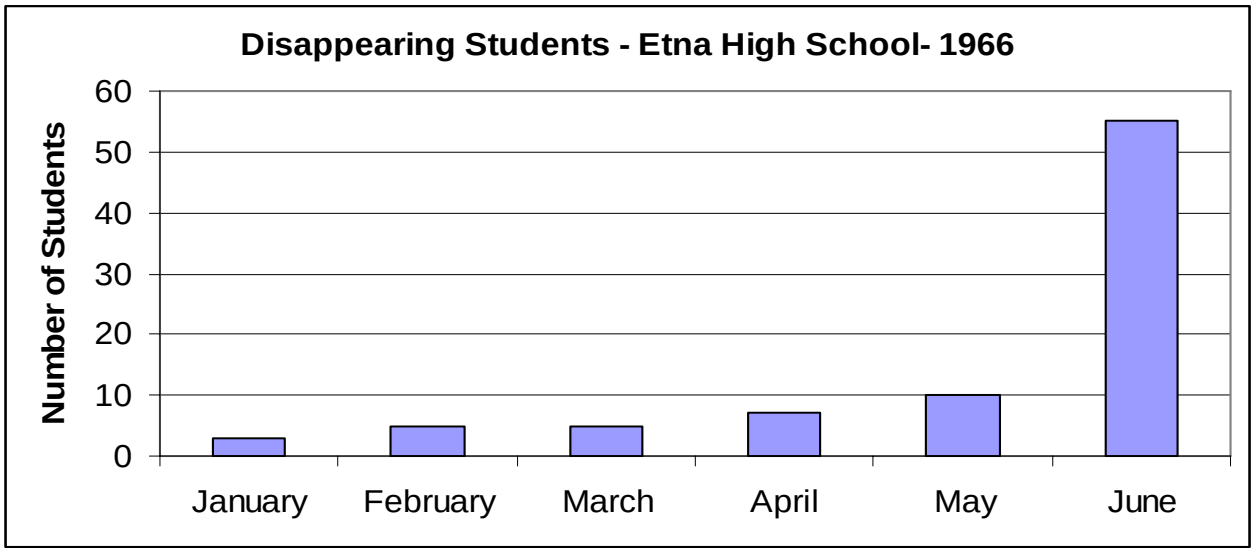
A Gallon Compared to Quarts, Pints, and Cups

C U P	C U P	C U P	C U P	C U P	C U P	C U P	C U P	C U P	C U P	C U P	C U P	C U P	C U P	C U P	C U P
Pint		Pint		Pint		Pint		Pint		Pint		Pint		Pint	
Quart				Quart				Quart				Quart			
Gallon															

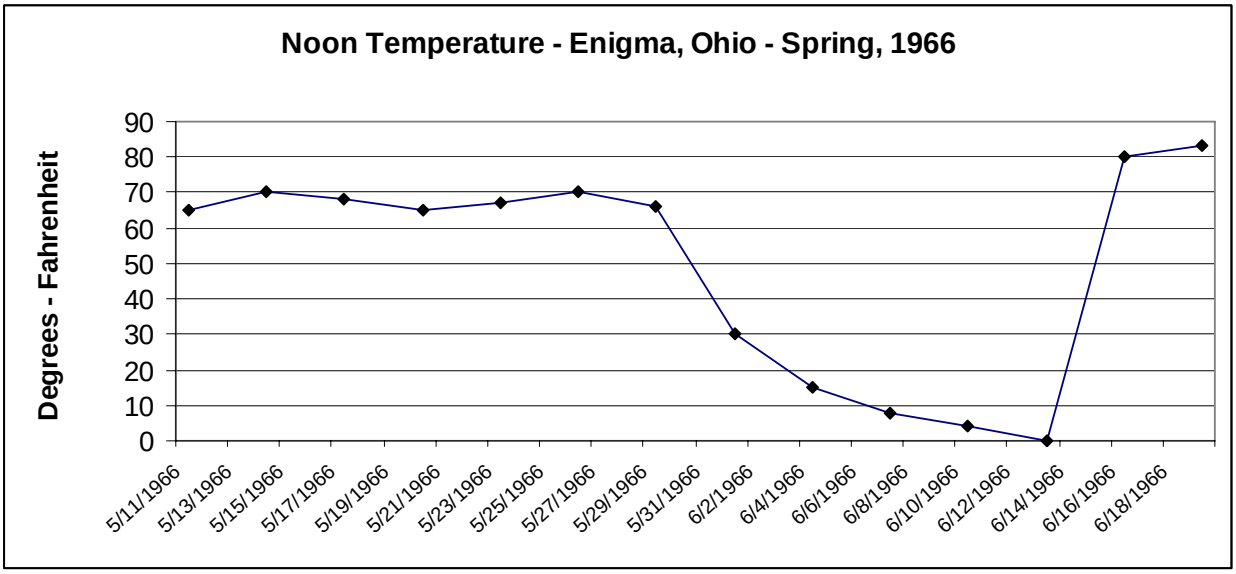
Pictograph:

Sightings at Enigma, Ohio • 1966	
January	
February	
March	
April	
May	
June	
Each  = 6 sightings	

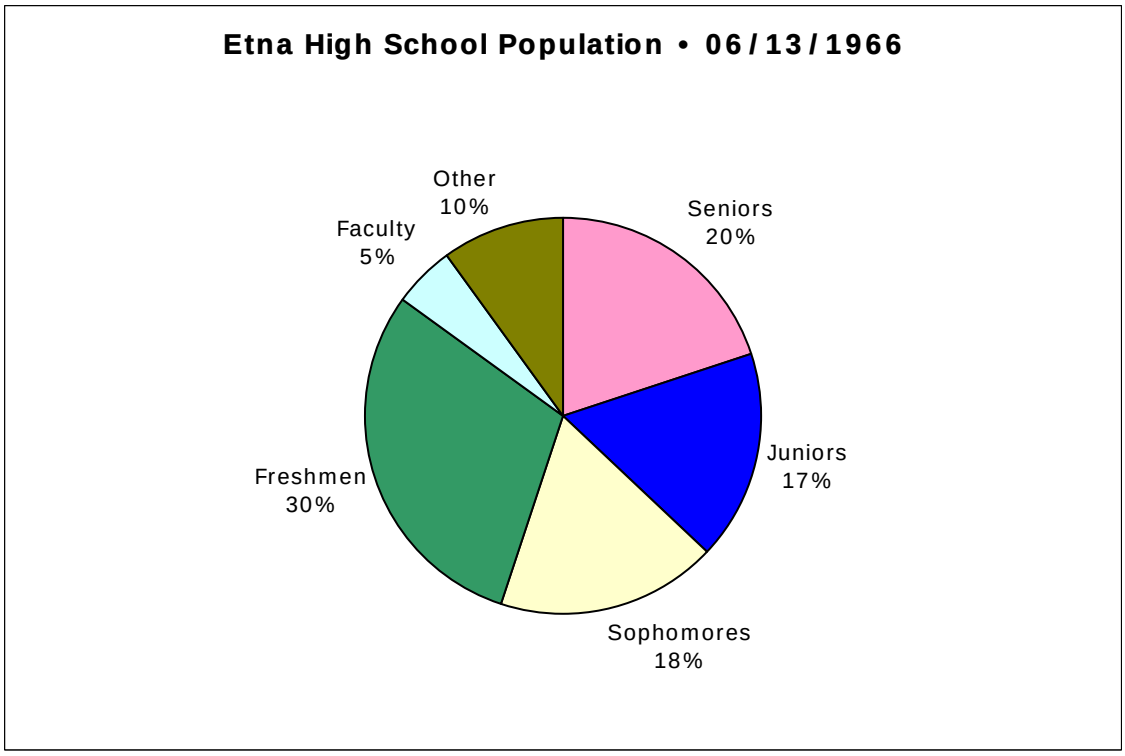
Bar Graph:



Line Graph:



Pie Graph:



Double Bar Graph

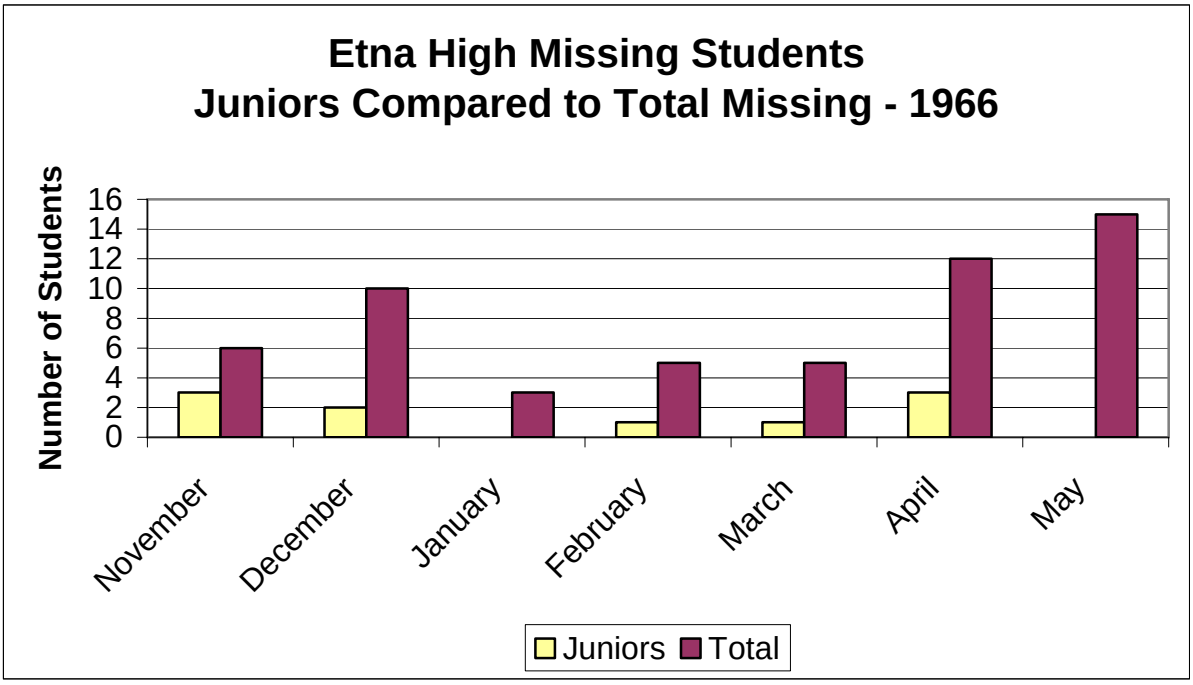


Table:

Monthly Disappearances by Grade Level Etna High School - 1966					
	Seniors	**Juniors**	**Sophomores**	**Freshmen**	**Total**
October	0	0	0	0	0
November	3	3	0	0	6
December	2	2	3	3	10
January	0	0	3	0	3
February	1	1	2	1	5
March	3	1	0	1	5
April	3	3	3	3	12
May	2	0	10	3	15

Frequency Table:

How large of a group of students vanished at a time?

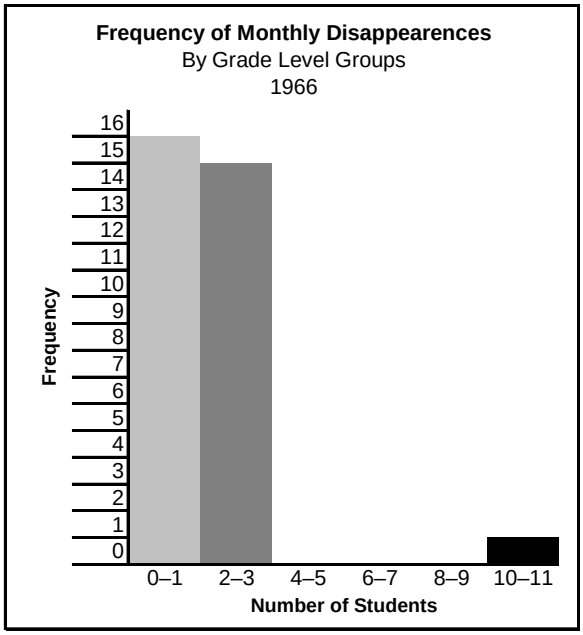
Monthly Disappearances by Grade Level An Examination of Frequency Etna High School 1966	
Number Missing in a Month	Frequency (by Grade Level)
0	11
1	5
2	4
3	11
10	1

Compare all three graph and plots on this page.

What are the advantages and disadvantages of each one?

Histogram:

Were students disappearing in large or small groups during 1966?



This histogram has an outlier.
What should be done about the outlying data?

Table:

Water Levels at Burns Reservoir 1965 and 1966		
Date	**Level 1965**	**Level 1966**
1/2	73 ft.	73 ft.
1/9	73 ft.	71 ft.
1/16	70 ft.	69 ft.
1/23	71 ft.	71 ft.
1/30	74 ft.	70 ft.
2/6	74 ft.	74 ft.
2/13	77 ft.	78 ft.
2/20	78 ft.	80 ft.
2/27	79 ft.	81 ft.
3/6	86 ft.	85 ft.
3/13	89 ft.	83 ft.
3/20	92 ft.	87 ft.
3/27	91 ft.	87 ft.
4/3	88 ft.	85 ft.
4/10	87 ft.	65 ft.
4/17	90 ft.	53 ft.
4/24	87 ft.	50 ft.
5/1	88 ft.	41 ft.
5/8	86 ft.	27 ft.
5/15	83 ft.	22 ft.
5/22	81 ft.	11 ft.
5/29	79 ft.	7 ft.
6/4	78 ft.	5 ft.

Stem-and-Leaf Plots:

Water Levels at Burns Reservoir
January 2nd to June 12th, 1965

7	0 1 3 3 4 4 7 8 8 9 9
8	1 3 6 6 7 7 8 8 9
9	0 1 2

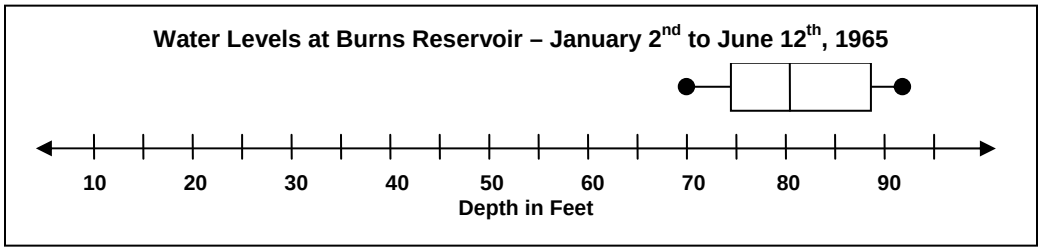
Key: 7|0 = 70

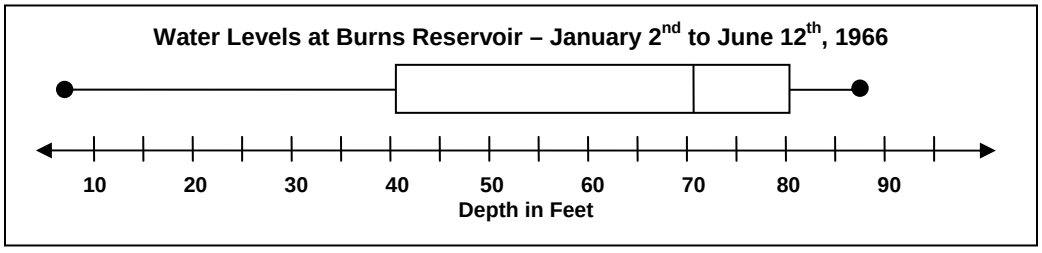
Water Levels at Burns Reservoir
January 2nd to June 12th, 1966

	5 7
1	1
2	2 7
3	
4	1
5	0 3
6	5 9
7	0 1 1 3 4 8
8	0 1 3 5 5 7 7

Key: 7|0 = 70

Box-and-Whisker Plots:





Compare all three tables and plots on this page. What are the advantages and disadvantages of each one?