Connecting the Data: Reading and Interpreting Graphs and Tables

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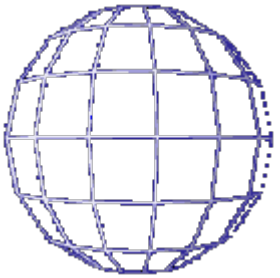


Focus on Reading and Interpreting Graphs and Tables

Let's Review!

- Identify one thing that you learned or used from the second session.
- Make a list of all of the different ways that you use graphs, tables, or charts in your daily life.

Focus on Reading and Interpreting Graphs and Tables

Math = Experiences

One picture tells a thousand words;

one experience tells a thousand pictures.

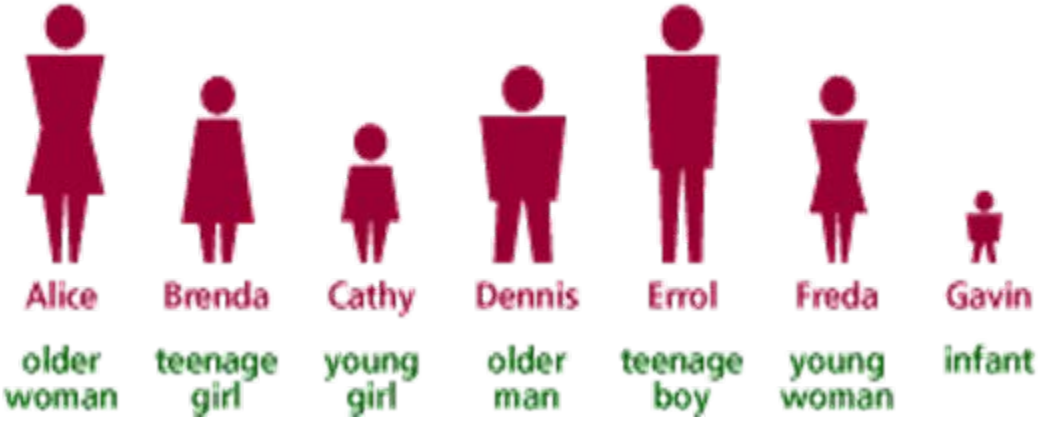
Focus on Reading and Interpreting Graphs and Tables

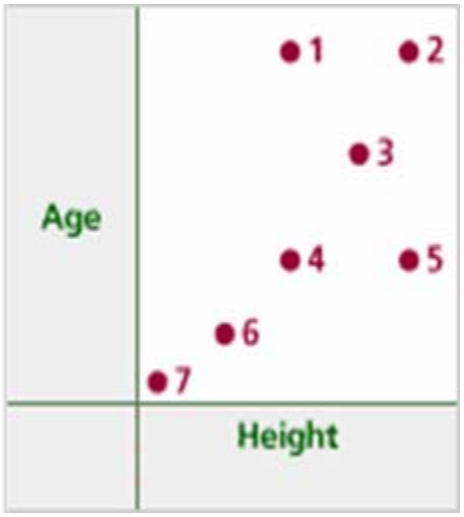
Math Themes – Most Missed Questions

- Theme 1: Geometry and Measurement
- Theme 2: Applying Basic Math Principles to Calculation
- **Theme 3: Reading and Interpreting Graphs and Tables**

Time Out for a Math Starter!

Let's get started problem solving with graphics by looking at the following graph. Who is represented by each point?





The Answers!

1 = Dennis
2 = Alice
3 = Freda
4 = Brenda
5 = Errol
6 = Cathy
7 = Gavin

NCTM Data Analysis and Probability Standard

All students should be able to:

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them
- Select and use appropriate statistical methods to analyze data
- Develop and evaluate inferences and predictions that are based on data

Principles and Standards for School Mathematics (NCTM, 2000)

NCTM Process Standards: Representation

All students should be able to:

- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply, and translate among mathematical representations to solve problems
- Use representations to model and interpret physical, social, and mathematical phenomena

Principles and Standards for School Mathematics (NCTM, 2000)

Teaching Graphic Literacy

Students may have problems with:

- Perception of graphics
- Inattention to the details of graphics
- Irrelevant data
- Inattention to questions
- Not using prior knowledge

Teaching Graphic Literacy

QAR – Question and Answer Relationships

- Identify the type of graphic to be analyzed
- Understand relationships in graphics
- Use QARs with questions and graphics

Teaching Graphic Literacy

QAR – Step 1

- Identify the type of graphic to be analyzed.
  - Present different types of graphs in the classroom
  - Identify main components of each type of graph
  - Construct a “key features table”

Teaching Graphic Literacy

QAR – Step 2

- Understand relationships in graphics
- Have students go on a graphic hunt and discuss the graphs, including such introductory questions as:
  - What does this graphic tell you?
  - What type of data do you see – words, numbers, or pictures?
  - How are the data organized?
  - Are the data shown in ways other than numbers and words?
  - What are the advantages and disadvantages of this particular graphic type?
  - Students may wish to add a "Uses" column to their "Key Features Table."
- Have students create graphs, tables, and charts to better understand relationships and answer introductory questions

Teaching Graphic Literacy

QAR – Step 3

- Analyze the question-answer relationships
- The four question-answer relationships are:
  - Right There Questions
  - Think and Search Questions
  - Author and You Questions
  - On My Own Questions

Teaching Graphic Literacy

Right There Questions

- The answer is in the graphic.
- The answer is usually easy to find. (You can put your finger on the page and point to the answer.)
- The words used to make up the question and **the words or numbers used to answer the question are Right There** in the graphic, often as one or more of the labels.

Teaching Graphic Literacy

Author and You

- The answer is not in the graphic.
- You can use the information you **already know** about the topic

AND

- Any information the **author has provided in the paragraph or graphic** to answer the question.
- Use your knowledge and the author's information to answer the question.

Teaching Graphic Literacy

Think and Search

- The answer is in the graphic; however, you must **put together different graphic elements** (titles, legend, data) to reach the answer.
- The words in the question and the **words or numbers needed to answer the question are not the same.**
- **Think and Search** different sections or elements of the graphic to answer the question. More than one graphic may need to be consulted.

Teaching Graphic Literacy

On Your Own

- The answer is **not in the graphic**.
- Using the information you **already know about the topic or based upon your experience,** you can answer the question.

HOWEVER

- Reading the graphic will usually expand your knowledge and will help you give a specific or clearer answer to the question.

Teaching Graphic Literacy

Using QAR for Multiple-Choice Questions

A Six-Step Process

- Read the question (not the answer choices)
- Review the graphic
- Reread the question
- Assign a QAR
- Answer the question
- Locate the answer in the answer choices

Teaching Graphic Literacy

- Identify the type of graphic to be analyzed.
  - Present different types of graphs in the classroom
  - Identify main components of each type of graph
  - Construct a “key features table”

Let's Look at Charts and Tables

Title → Price of Corn versus Quantity Demand

Column

Labels

One Cell

Price per Bushel (dollars)	Quantity Demanded per Week (bushels)
5	10
4	20
3	35
2	55
1	80

Teaching Graphic Literacy

QAR – Step 2

- Understand relationships in graphics
- Answer introductory questions:
  - What does this graphic tell you?
  - What type of data do you see – words, numbers, or pictures?
  - How are the data organized?
  - Are the data shown in ways other than numbers and words?
  - What are the advantages and disadvantages of this particular graphic type?
  - Students may wish to add a "Uses" column to their "Key Features Table."
- Create graphs, tables, and charts

Constructing a Chart or Table

During the 1995-1996 academic year, a survey of the holdings of university research libraries and rank was done in the United States and Canada. It was found that Syracuse University, in New York, had 2,392,147 holdings, and was figured to rank eighty-first. Harvard University ranked first with 13,369,855 holdings. The University of Connecticut was ranked fiftieth place, and reported 2,626,066 holdings. The Massachusetts Institute of Technology reported 2,448,647 holdings, and was ranked in seventy-third place. (Source: Association of Research Libraries)

Constructing a Chart or Table

Holdings and Rank of University Research Libraries in the U. S. and Canada – 1995-1996

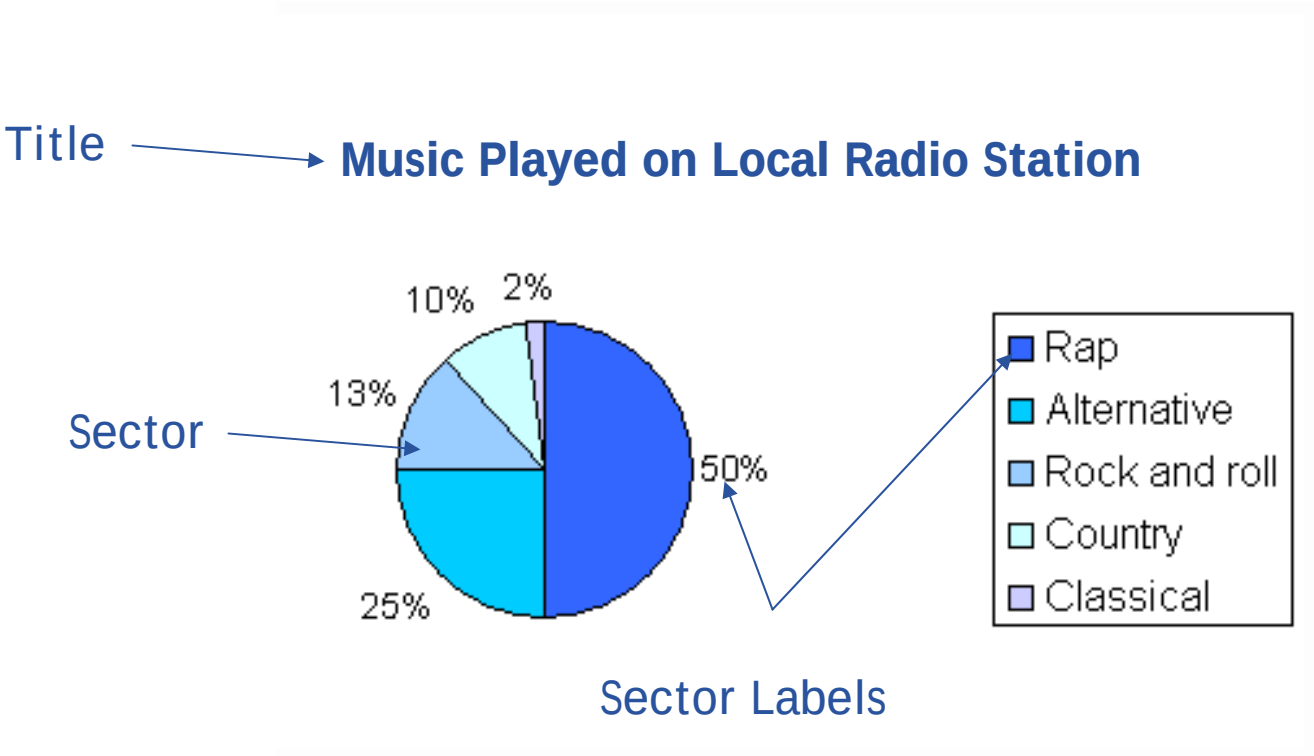
Institution	Rank	Holdings
Harvard University	1	13,369,855
U. of Connecticut	50	2,626,06
Mass. Institute Tech.	73	2,448,647
Syracuse University	81	2,392,147

Circle Graphs/Pie Charts

Circle graphs or pie charts have the following properties:

- They are circular shaped graphs with the entire circle representing the whole.
- The circle is split into parts or sectors.
- Each sector represents a part of the whole.
- Each sector is proportional in size to the amount each sector represents; therefore it is easy to make generalizations and comparisons.

Circle Graphs/Pie Charts



Constructing Circle Graphs/Pie Charts

To create a circle graph/pie chart, the following things must be determined:

- Suitability of Data
- Calculate Percentages
- Draw the Graph
- Title and Label the Graph

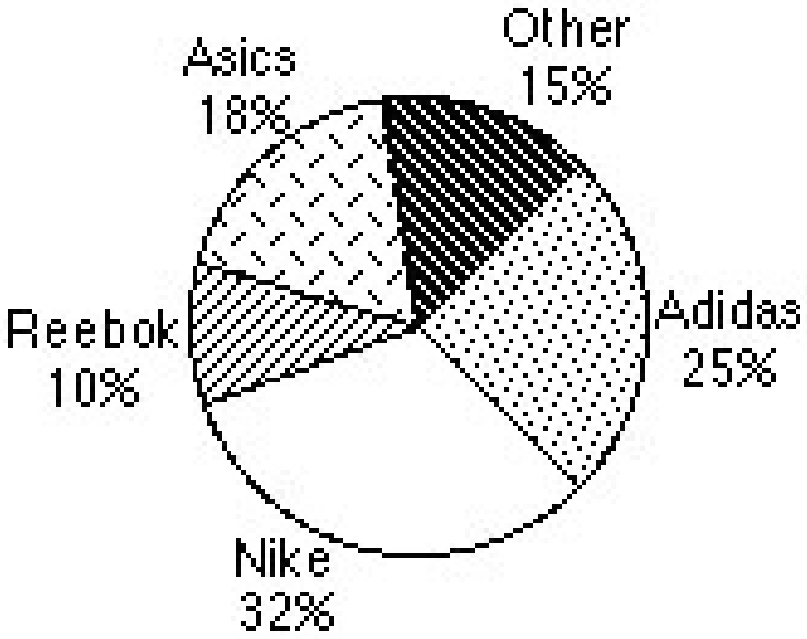
Constructing Circle Graphs/Pie Charts

Tennis Shoes Sold for November 2006 at The Shoe Factory

Brand Name	Number Sold
Adidas	150
Nike	192
Reebok	60
Asics	108
Other	90

Circle Graphs/Pie Charts

Tennis Shoes Sold for November 2006 at The Shoe Factory



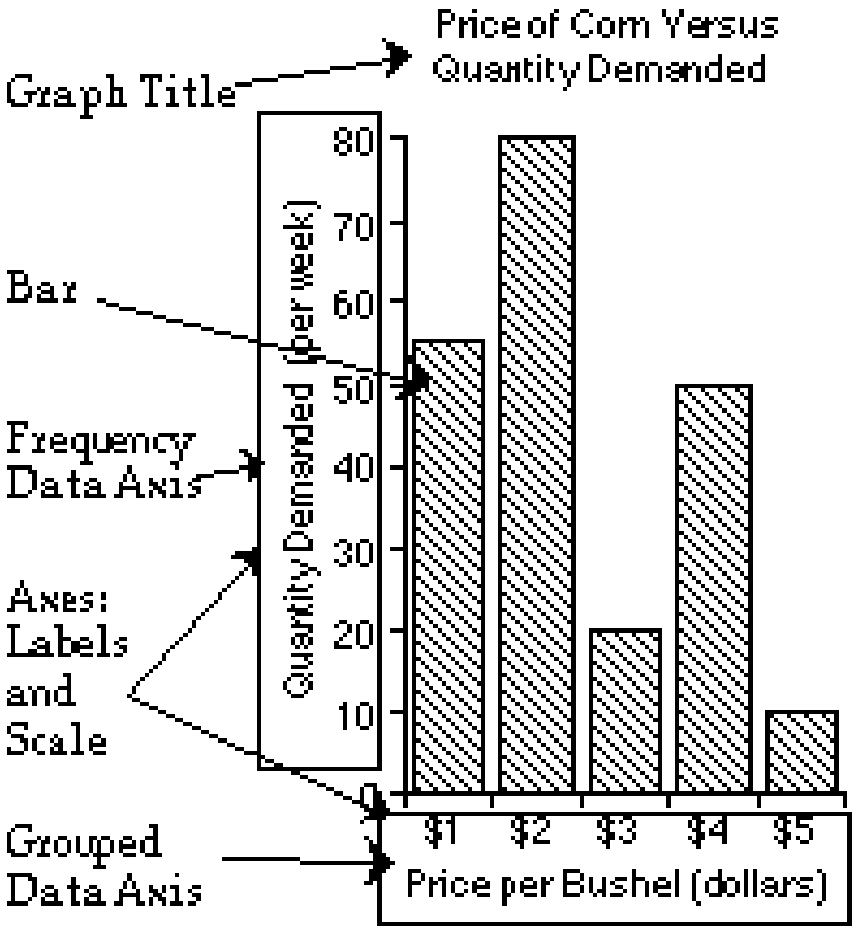
Bar Graphs

A bar graph is a visual display used to compare the amounts or frequency of occurrence of different characteristics of data. Bar graphs are generally used to:

- **compare groups of data**
- **make generalizations about data**

Bars can be displayed vertically or horizontally. Bar graphs can also show data through individual or multiple bars for each element.

Bar Graphs


Price of Corn Versus Quantity Demanded
Graph Title
Bar
Frequency Data Axis
Axes: Labels and Scale
Grouped Data Axis
Quantity Demanded (per week)
80
70
60
50
40
30
20
10
0
$1
$2
$3
$4
$5
Price per Bushel (dollars)

Constructing Bar Graphs

To create a bar graph, the following things must be determined:

- Title of the Graph
- Label Each Axis
- Determine the Scale for Each Axis
- Determine Frequency Axis
- Data Entry

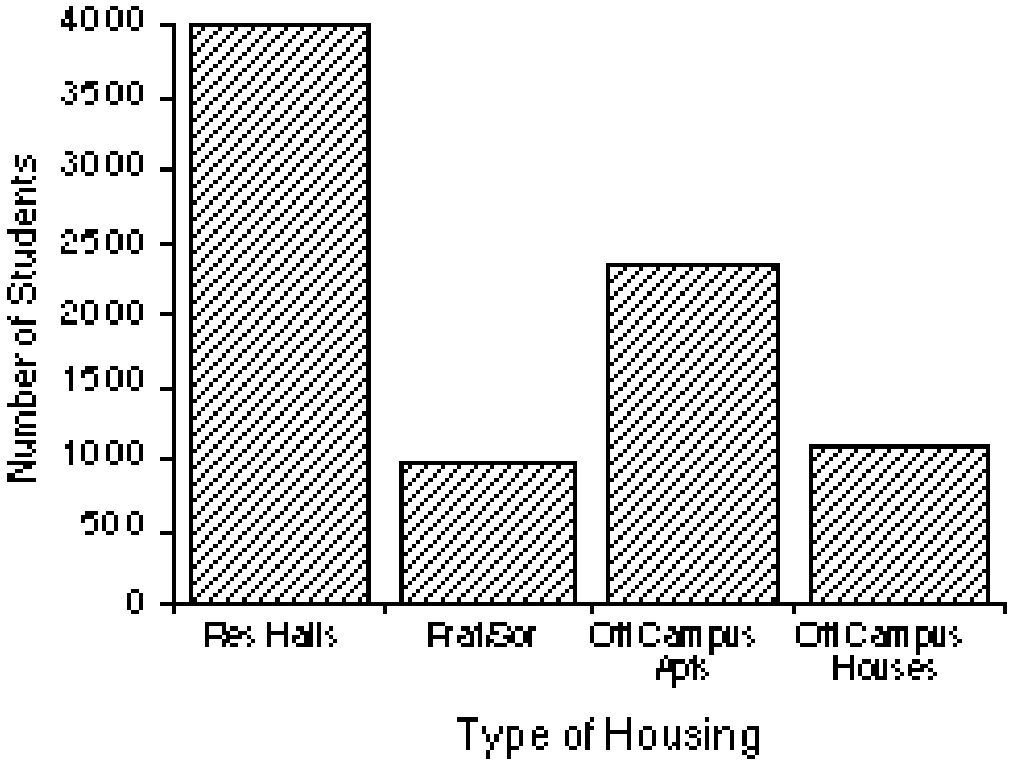
Constructing Bar Graphs

Student Housing at ABC University During 2006

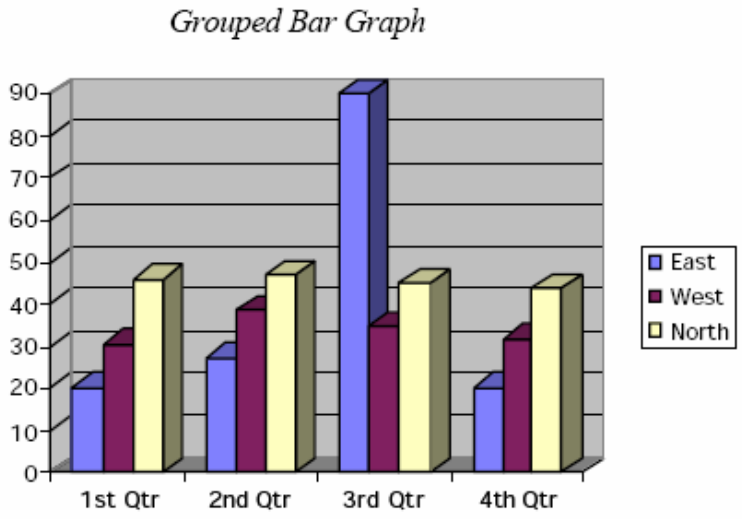
Type of Housing	Number of Students
Residence Halls	3995
FraternitySorority Houses	985
Off-Campus Apartments	2347
Off-Campus Houses	81

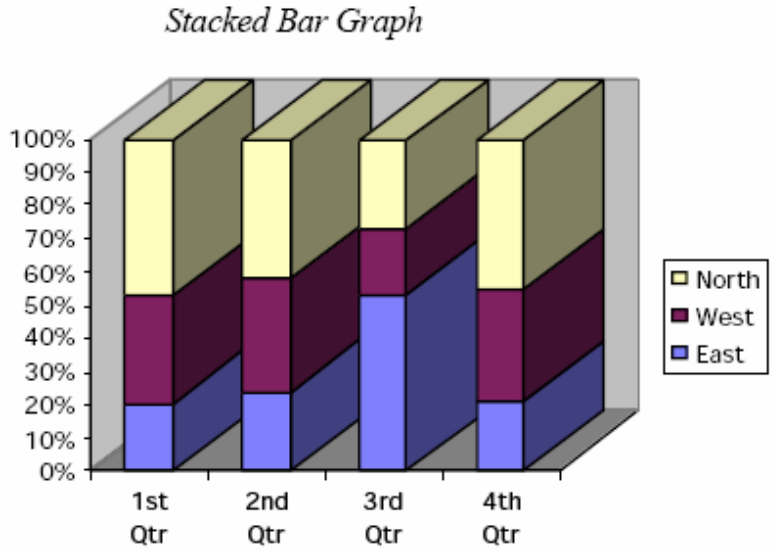
Constructing Bar Graphs

Student Housing at ABC University During 2006



Multiple-Bar Graphs





Let's Compare!

- Read the nutrition facts panel of two different cereals.
- Create a double-bar graph to show how nutrition values compare for the two cereals.
  - Identify the categories that you will use.
  - Determine how you will compare and contrast the information.
  - Create a graph that will accurately and clearly display the data.

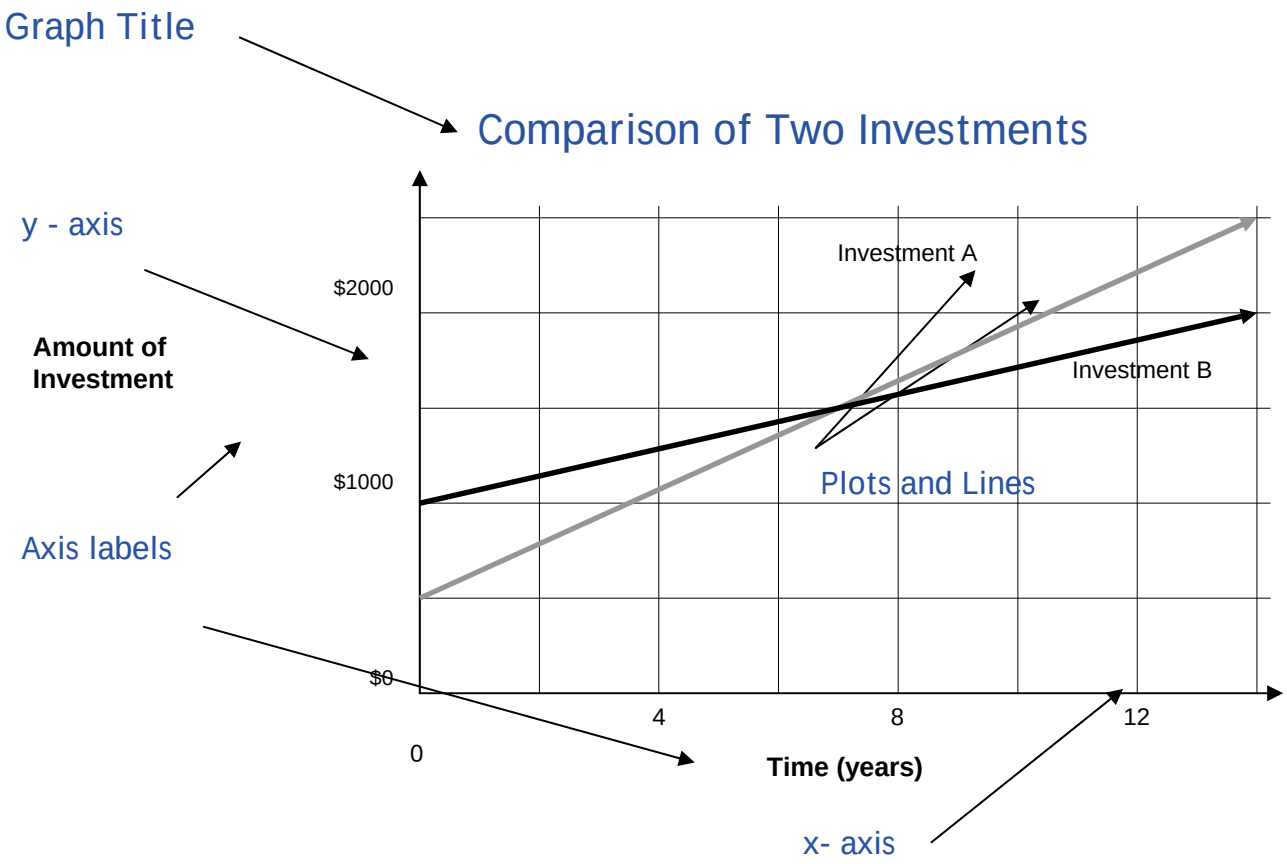
Line Graphs

A line graph is used to show continuing data; how one thing is affected by another.

Line graphs have the following properties:

- An x and a y axis that indicate independent and dependent variables
- Points that may or may not be connected by a line located on a grid
- Show trends

Line Graphs


Graph Title
Comparison of Two Investments
y - axis
Amount of Investment
Axis labels
$2000
$1000
$0
0
4
8
12
Time (years)
Investment A
Investment B
Plots and Lines
x- axis

Constructing Line Graphs

To construct a line graph on paper, use the following steps.

- Gather the Data & Identify the Variables
- Determine the Scale
- Number and Label the Axes
- Plot the Data Points
- Connect the Points & Draw the Graph
- Title the Graph & Add a Legend (if needed)

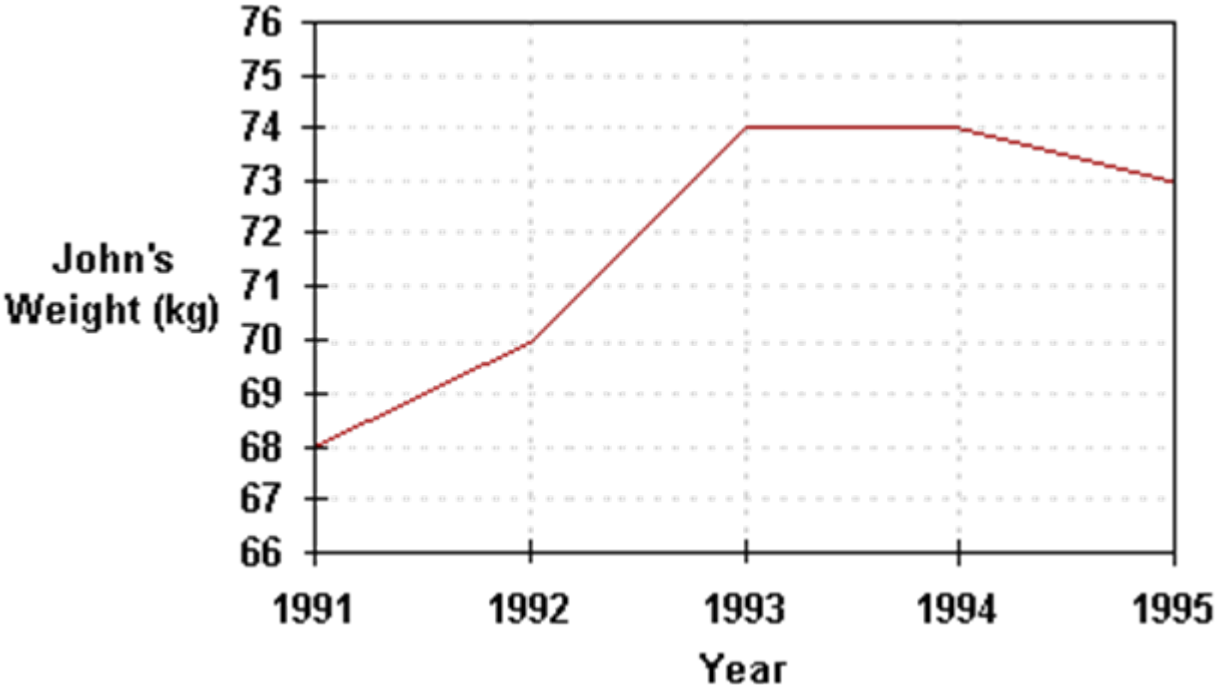
Constructing Line Graphs

John's Weight from 1991-1995

Year	John's Weight (kg)
1991	68
1992	70
1993	74
1994	74
1995	73

Constructing Line Graphs

John's Weight from 1991-95



Scatter Plots

Scatter plots:

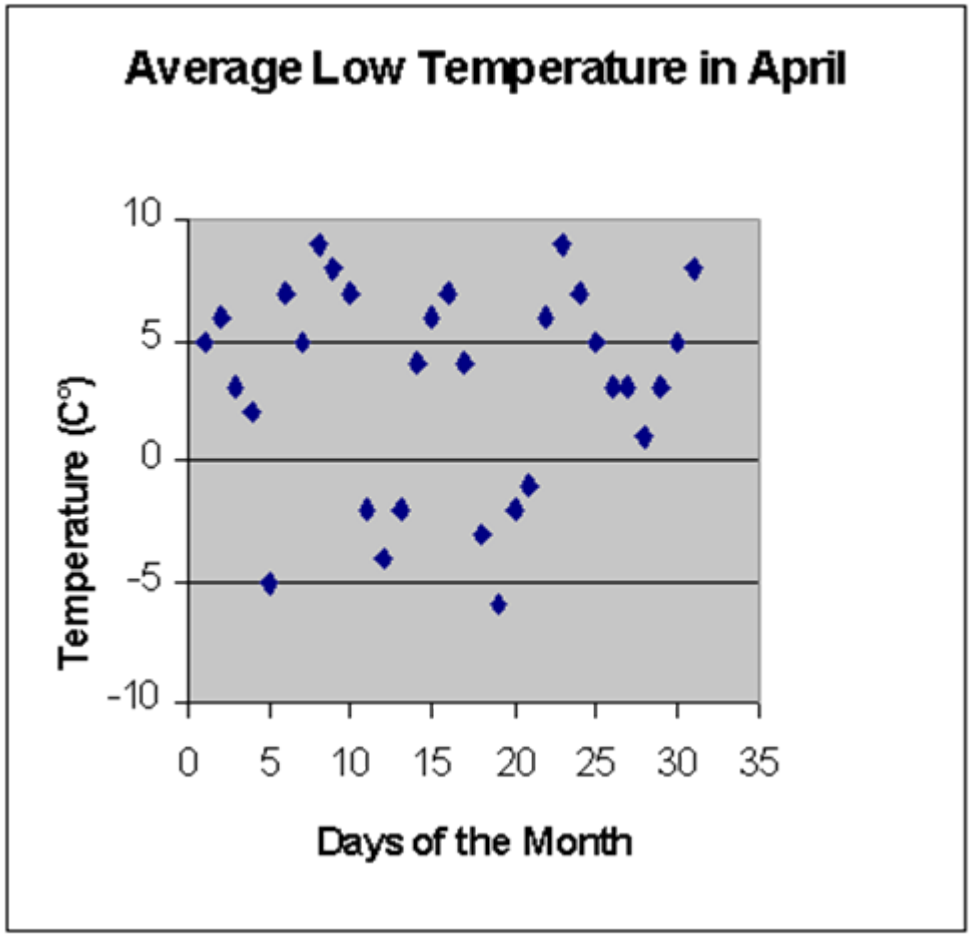
- Are similar to line graphs
- Show how much one variable is affected by another (correlation)
- Consist of a large body of data

Making the Connection!

Now It's Your Turn – Creating Data for Graphs

- Create a survey for your students to complete.
- Develop ten questions for the survey.
- Create a format for the survey.
- Think about what types of graphs could be developed.

Scatter Plots



Map It Out!

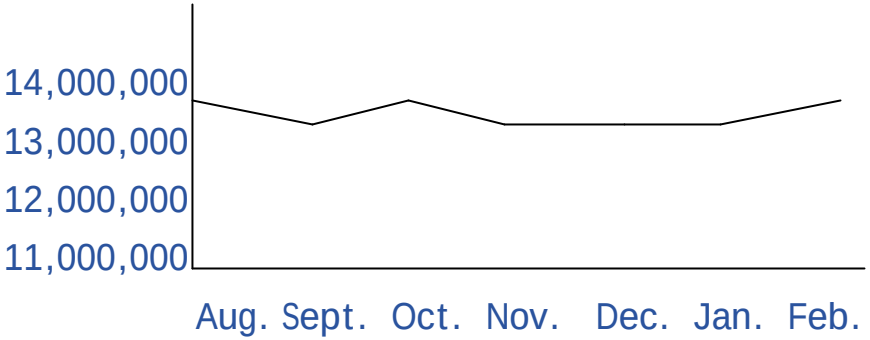
Teaching Graphic Literacy

QAR – Step 3

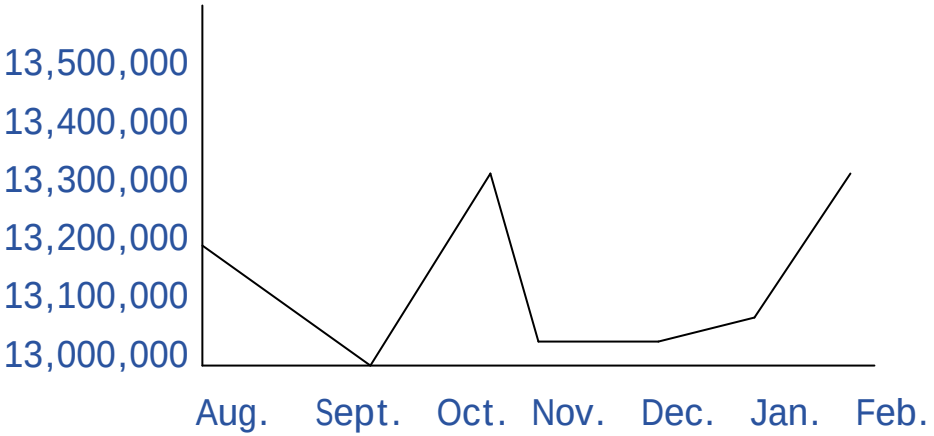
- Analyze the question-answer relationships
- The four question-answer relationships are as follows:
  - Right There Questions
  - Think and Search Questions
  - Author and You Questions
  - On My Own Questions

Two Graphs: Two Sets of Data?

Graph A: Unemployment Numbers



Graph B: Unemployment Numbers



Misleading Graphics

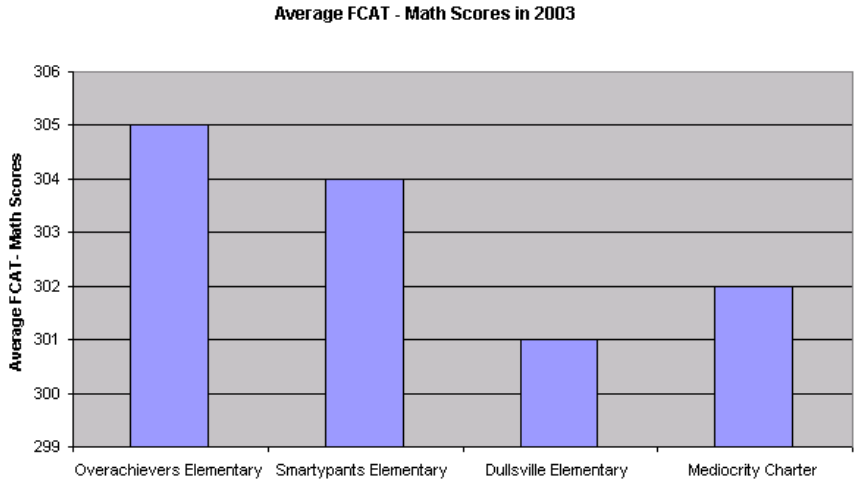
There are three kinds of lies: lies, damned lies, and statistics.

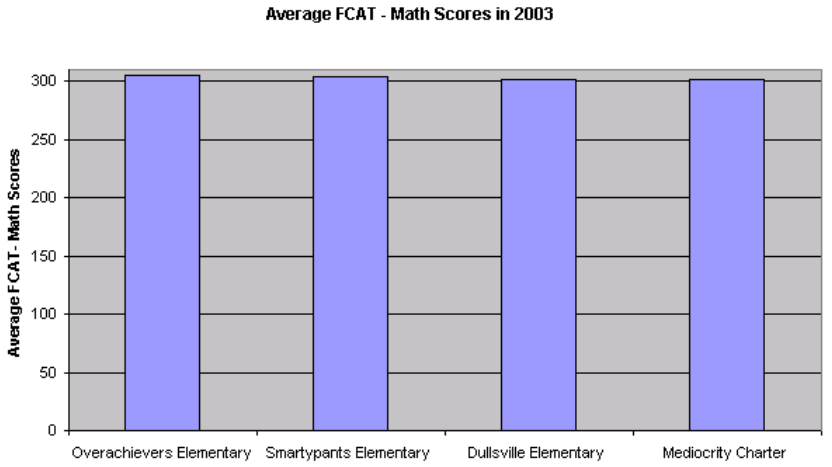
Benjamin Disraeli (1804-1881)

Misleading Statistics

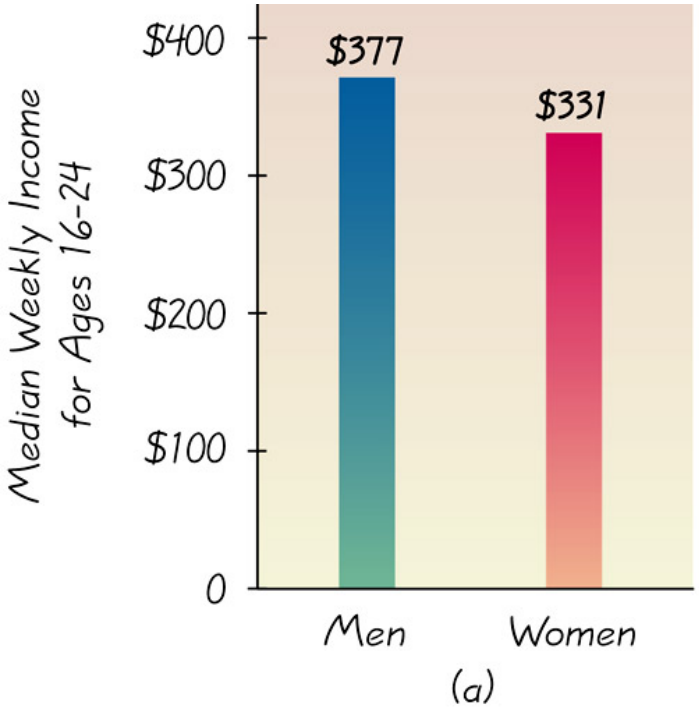
- Misleading Graphs
  - Bias
  - Distortion
  - Scale

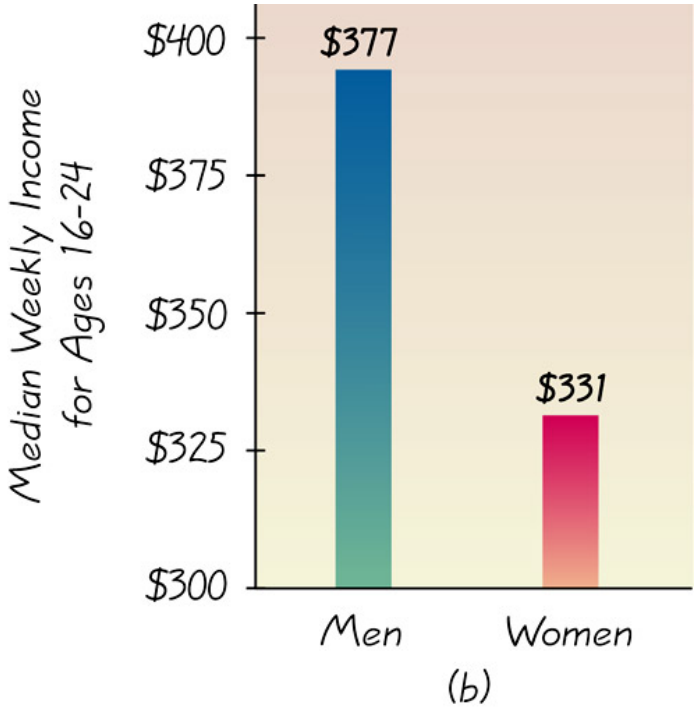
Misleading Graphics – Missing Zero



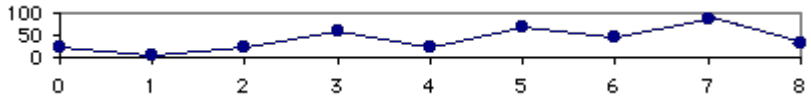


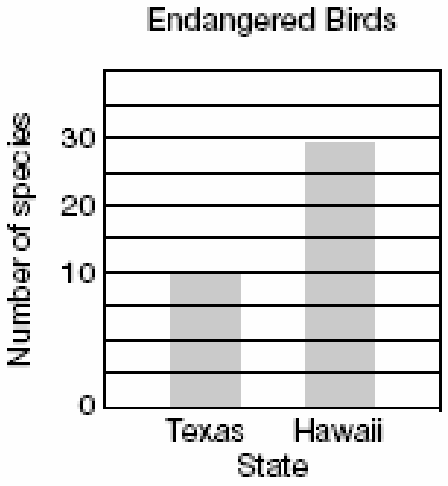
Misleading Graphics – Distorted Scale



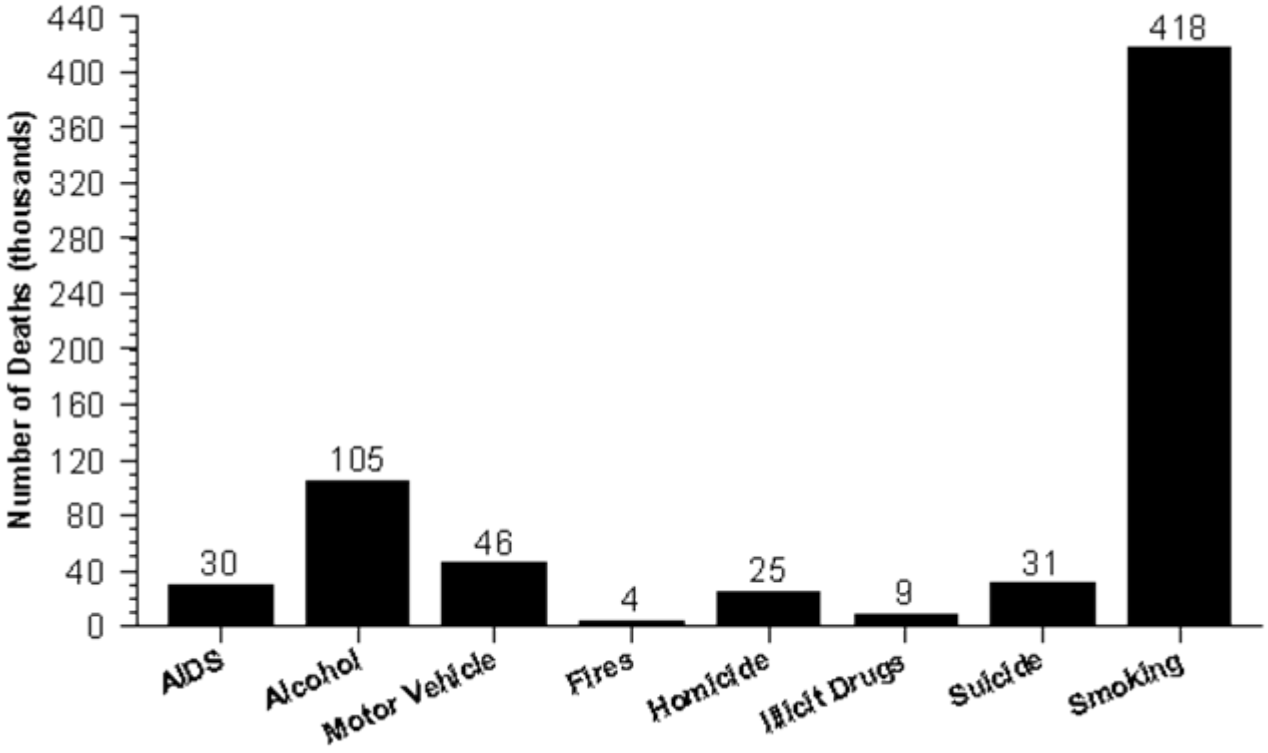


Misleading Graphics – Distorted Scale

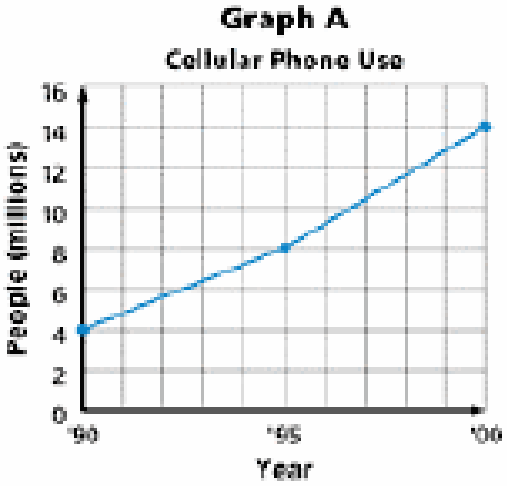


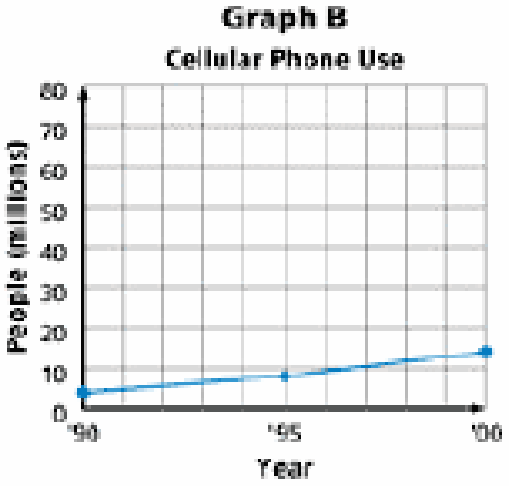


Misleading Graphics – Missing Categories



Misleading Statistics – Looks Like a Bias

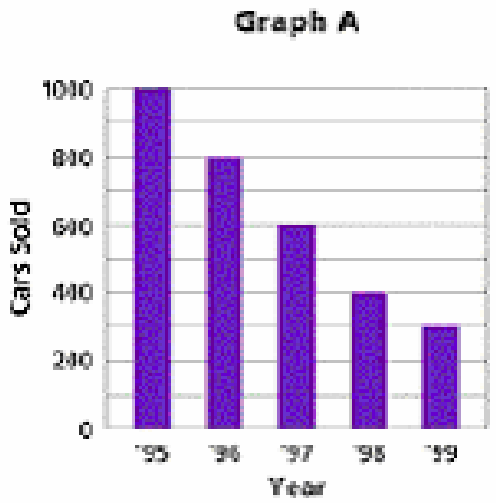


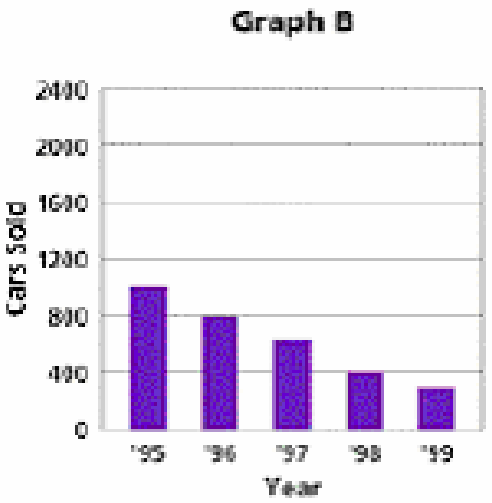


Why do the graphs look different?

Which graph appears to show a greater increase in the use of cellular phones?

Misleading Statistics – Looks Like a Bias

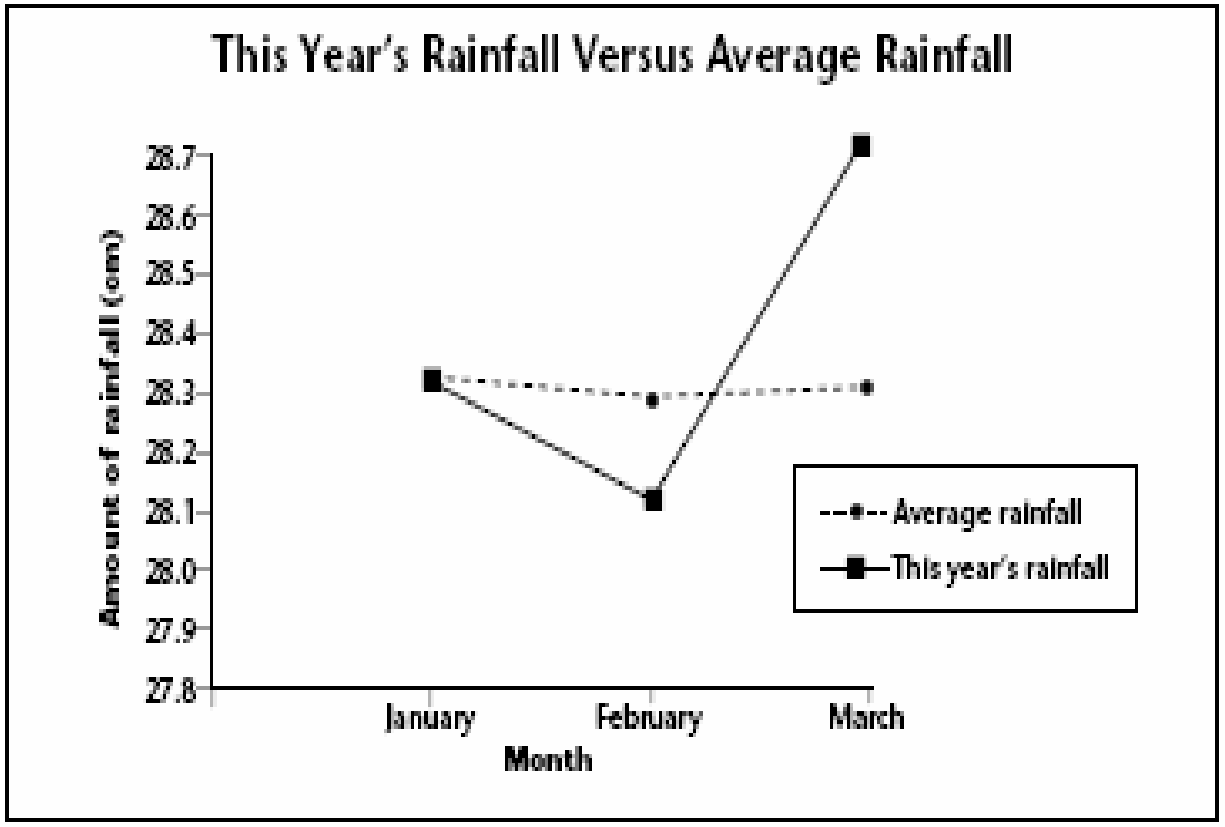




Why do the graphs look different?

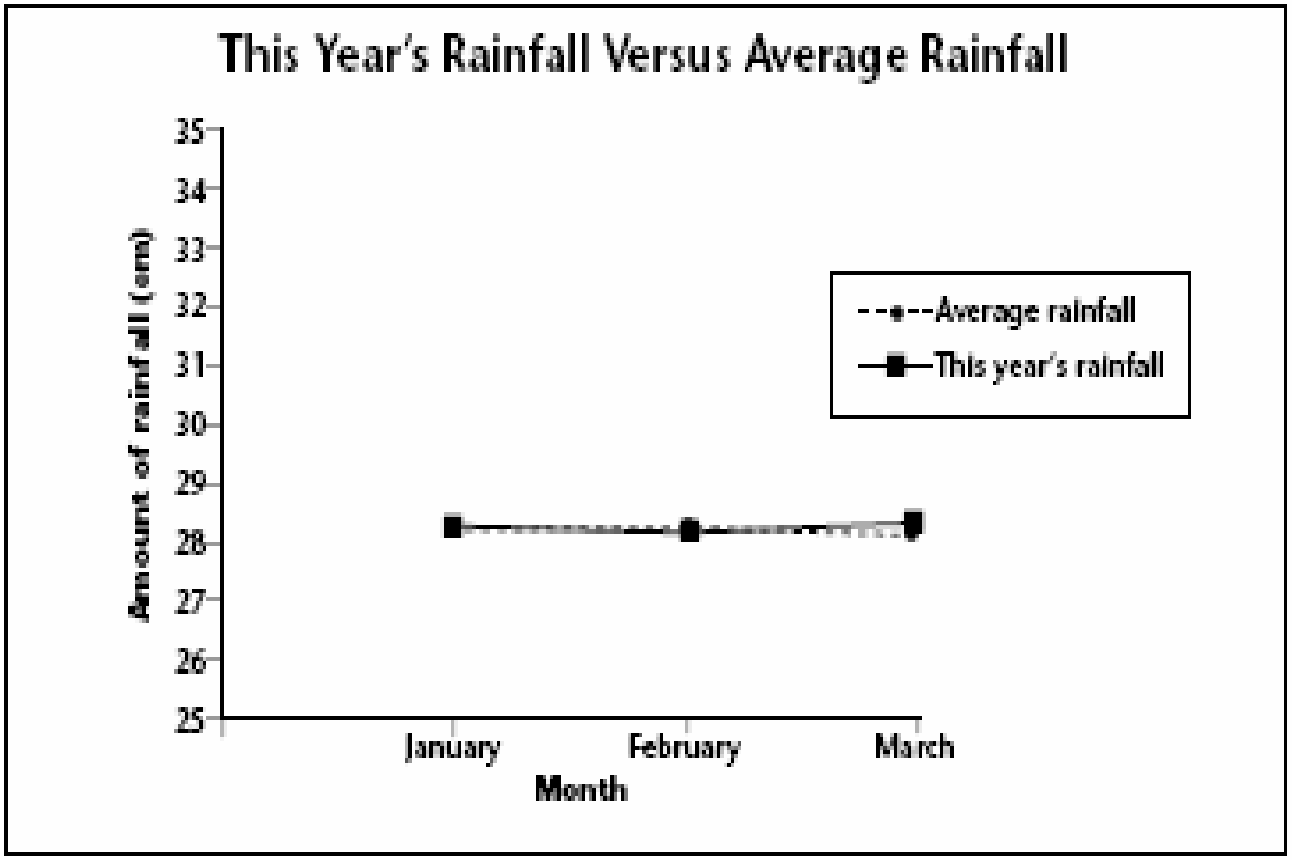
Which graph would be most effective in negative advertisement by a competing car company? Why?

Misleading Statistics – Looks Like a Bias



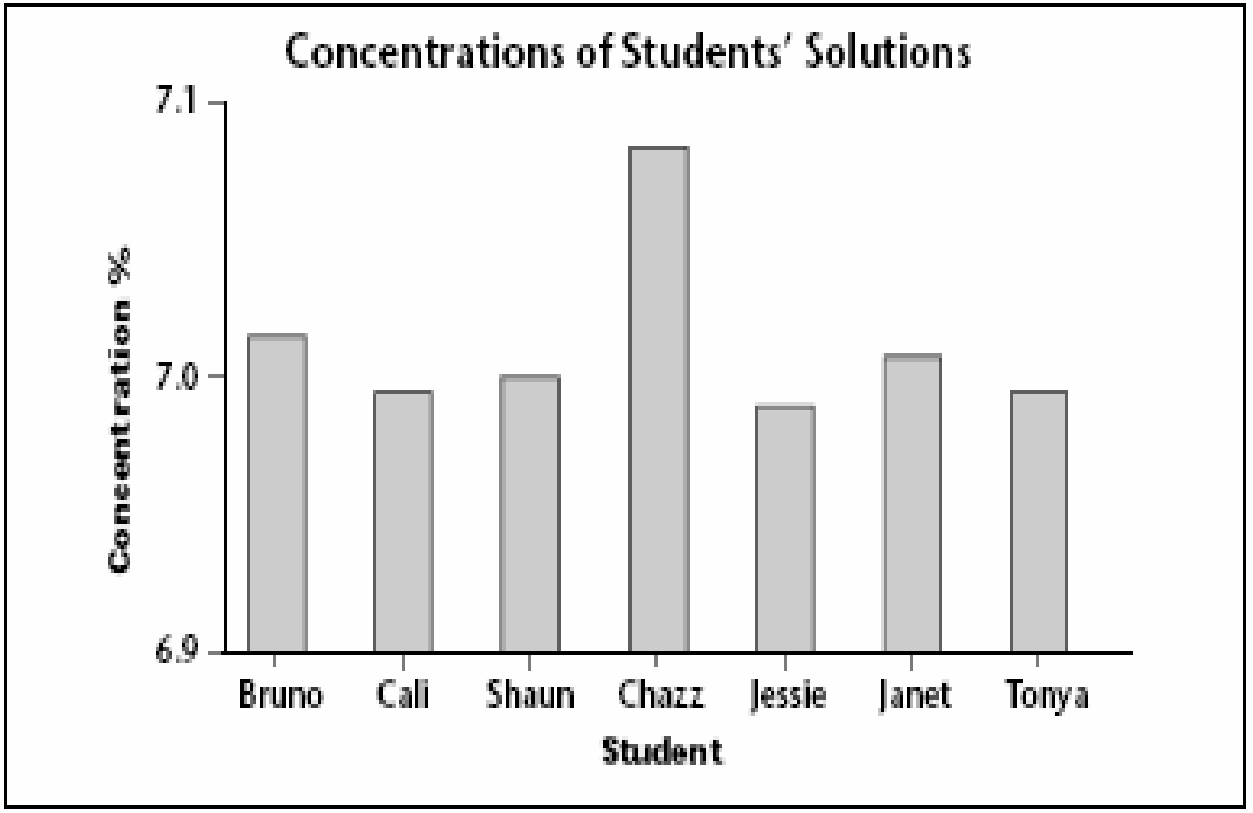
How is the graph misleading?

Misleading Statistics – Looks Like a Bias



Is this more accurate? Why or why not?

Misleading Statistics – Looks Like a Bias

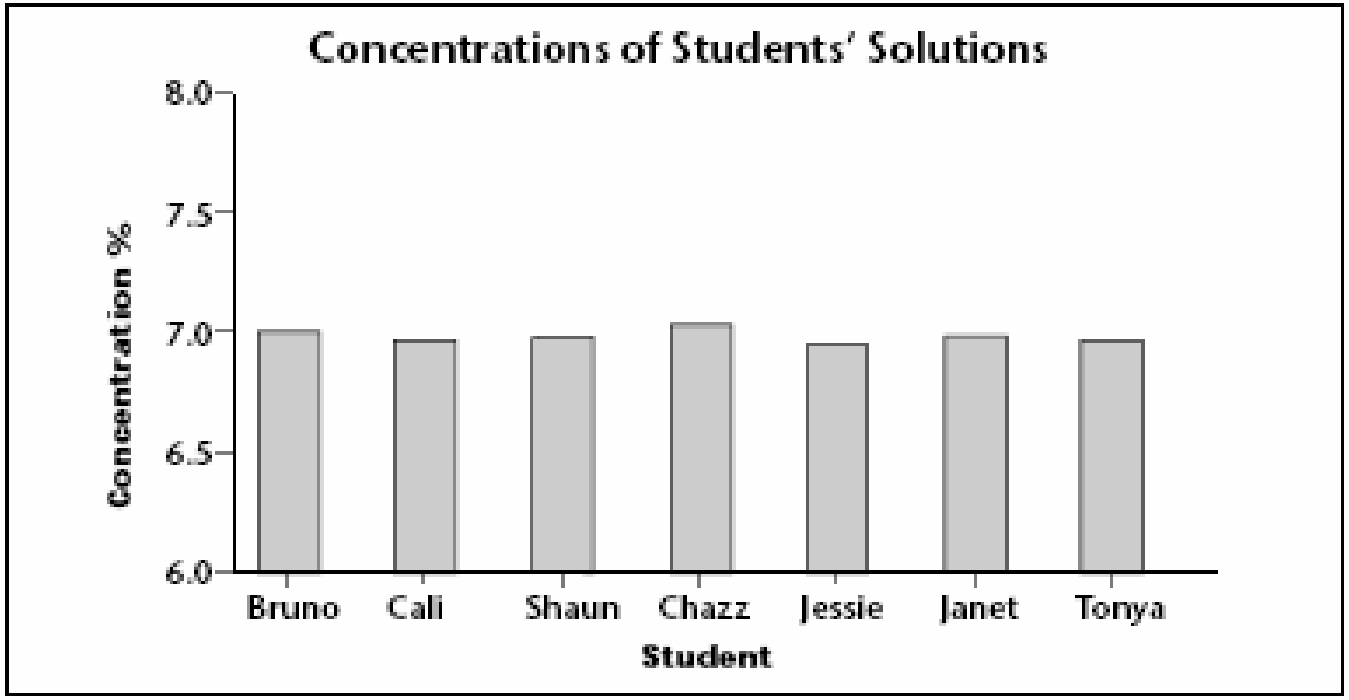


What is this graph trying to communicate?

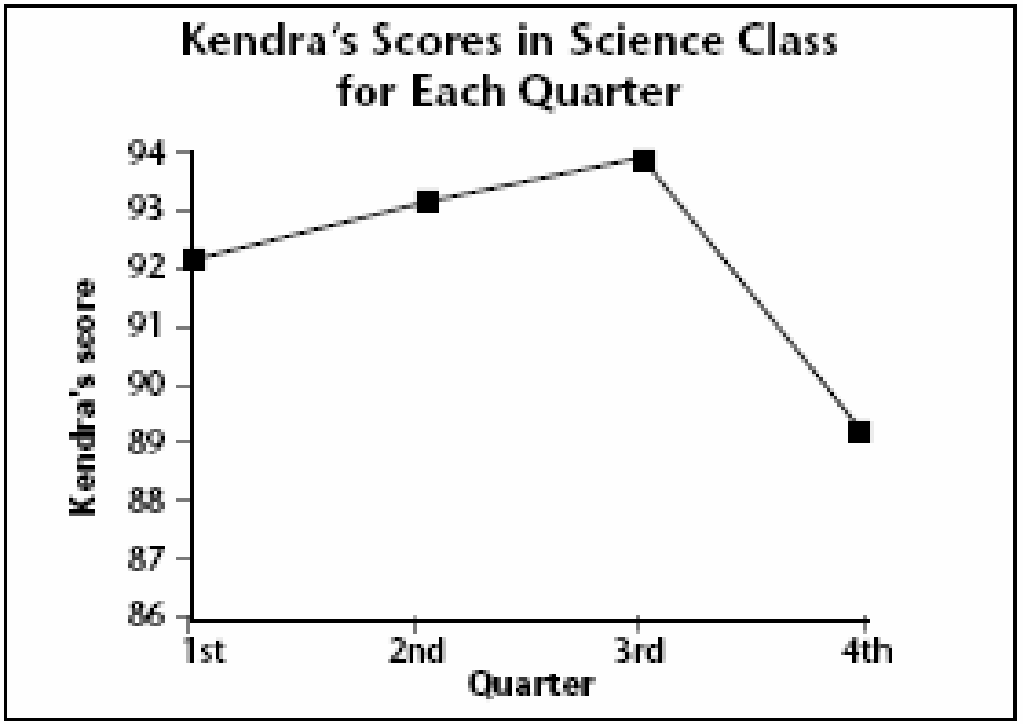
Misleading Statistics – Looks Like a Bias

Concentrations of Students' Solutions

Name	Bruno	Cali	Shaun	Chazz	Jessie	Janet	Tonya
Concentration	7.02%	6.99%	7.00%	7.08%	6.97%	7.01%	6.99%

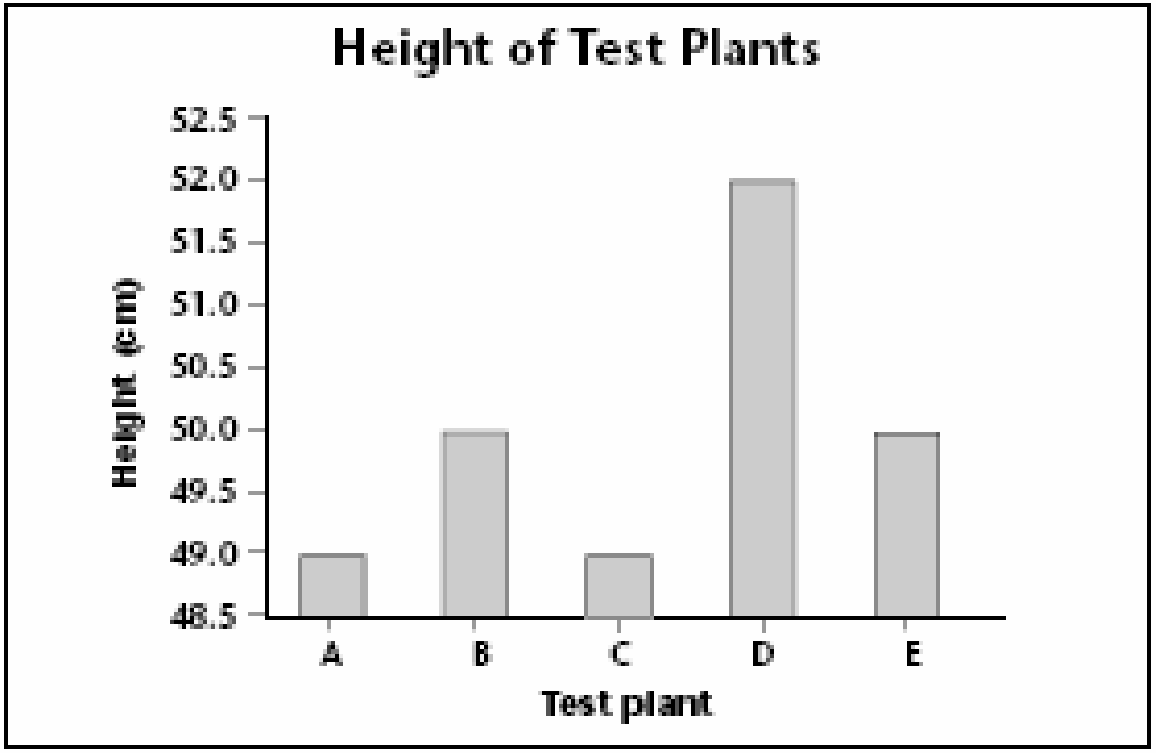


Misleading Statistics – Looks Like a Bias



This graph shows that Kendra received a much lower grade in science class during the fourth quarter. Do you think what appears to be such a large drop in her grades should worry Kendra? Explain your reasoning.

Misleading Statistics – Looks Like a Bias



This graph shows that test plant D grew much taller than the other plants. How is this information misleading?

Misleading Statistics – Looks Like a Bias

Layer of Rock Thickness

Layer	A	B	C	D
Thickness	11.2	10.8	13.5	11.1

Using the above data, create two graphs. First show how similar the measurements are. In your second graph, emphasize the fact that layer C was slightly thicker than the other layers.

Teaching Graphic Literacy – Let's Review!

Using QAR for Multiple-Choice Questions

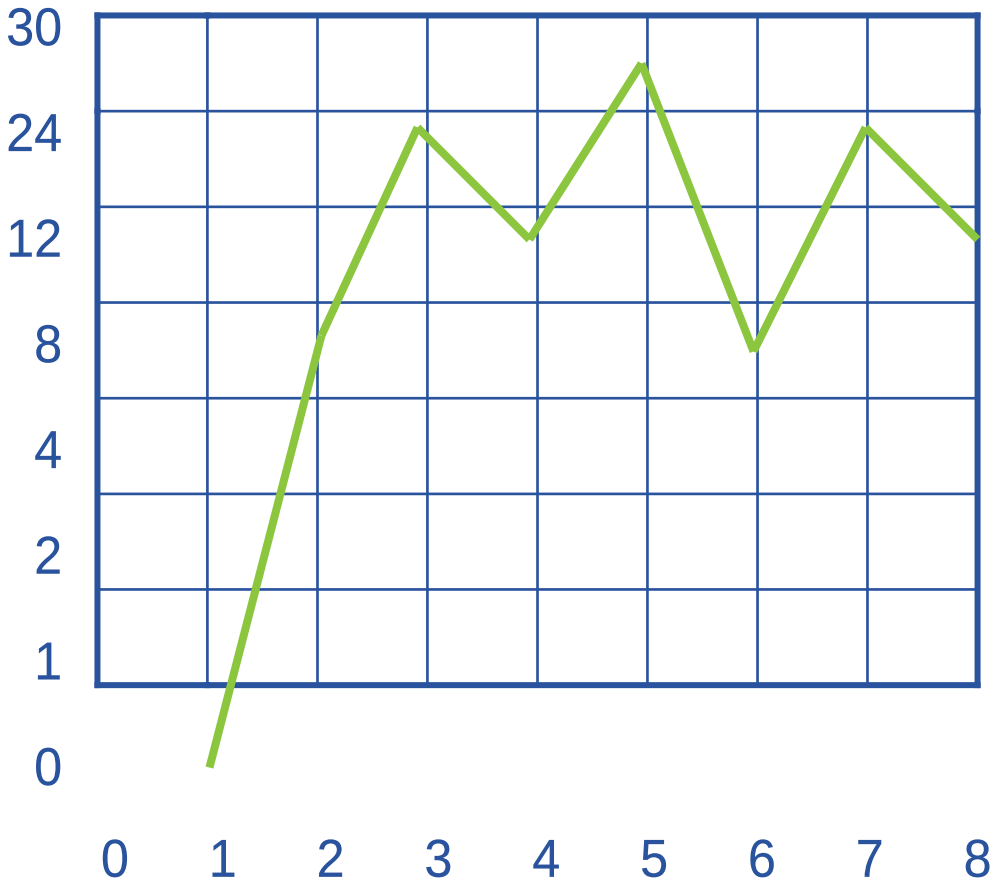
A Six-Step Process

- Read the question (not the answer choices)
- Review the graphic
- Reread the question
- Assign a QAR
- Answer the question
- Locate the answer in the answer choices

Focus on Reading and Interpreting Graphs and Tables

Let's Look at the Problem Areas!

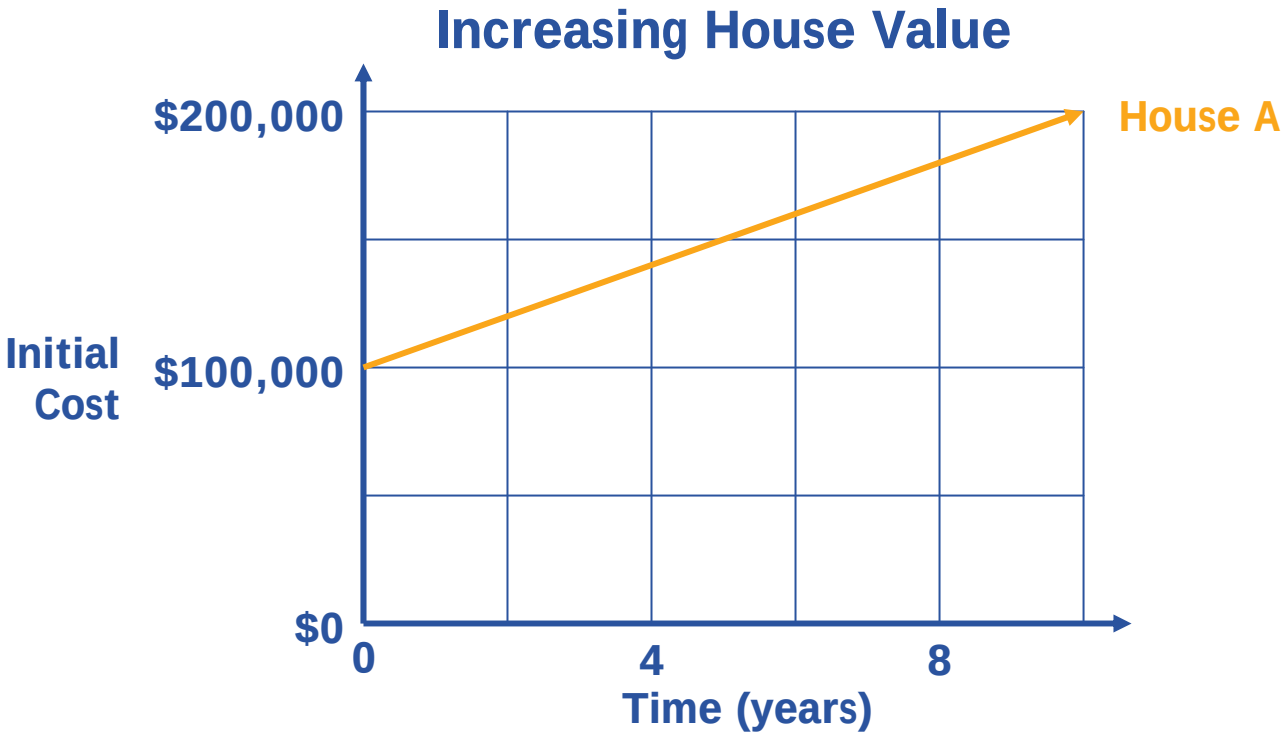
Let's Begin!



Most Missed Questions: Reading and Interpreting Graphs and Tables

- Comparing graphs
- Transitioning between text and graphics
- Interpreting values on a graph
- Interpreting table data for computation
- Selecting table data for computation

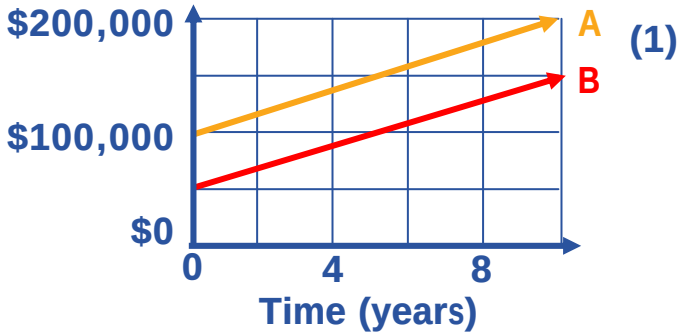
Most Missed Questions: Reading and Interpreting Graphs and Tables

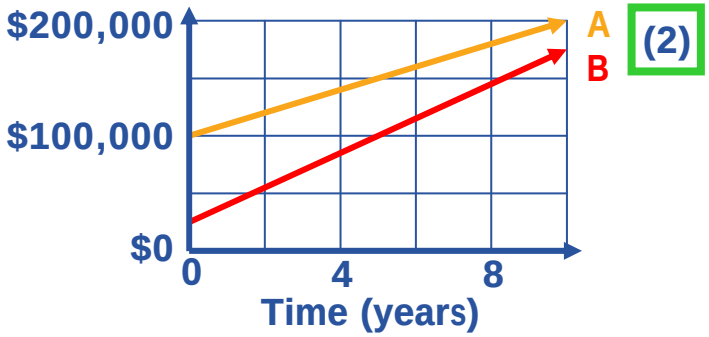


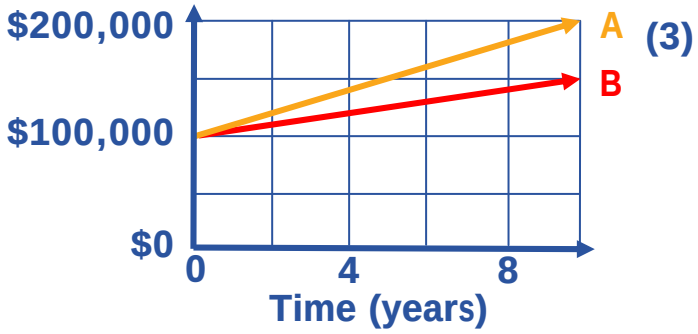
House A cost $100,000 and increased in value as shown in the graph.

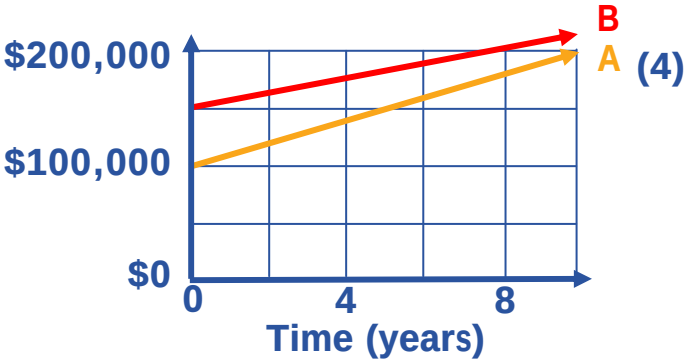
House B cost less than house A and increased in value at a greater rate. Sketch a graph that might show the changing value of house B.

Most Missed Questions: Reading and Interpreting Graphs and Tables

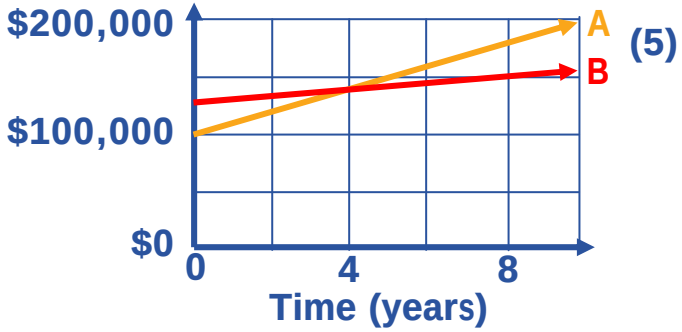






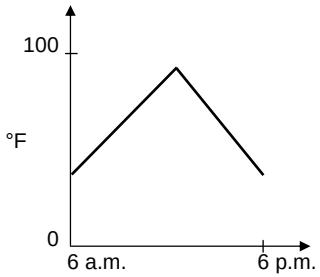


Which One?

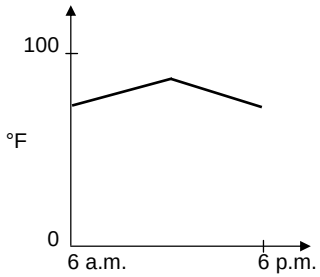


Most Missed Questions: Reading and Interpreting Graphs and Tables

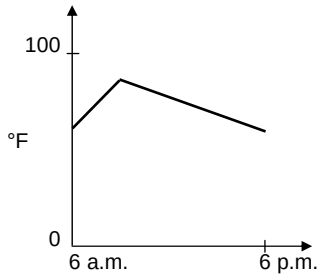
The temperature at 6:00 a.m. on Monday was 60° F. The temperatures rose steadily until it reached a maximum of 85° F at 3:00 p.m. The temperature then dropped steadily and again was at 60° F at 6:00 p.m. Which graph represents this time-temperature relationship?



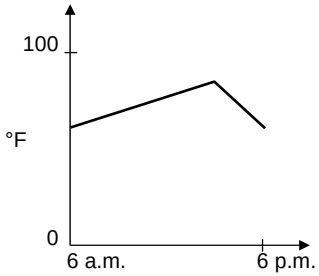
(1)



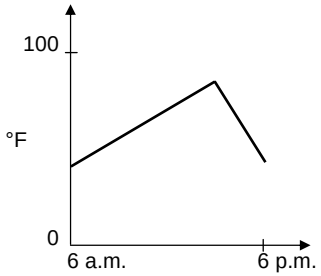
(2)



(3)



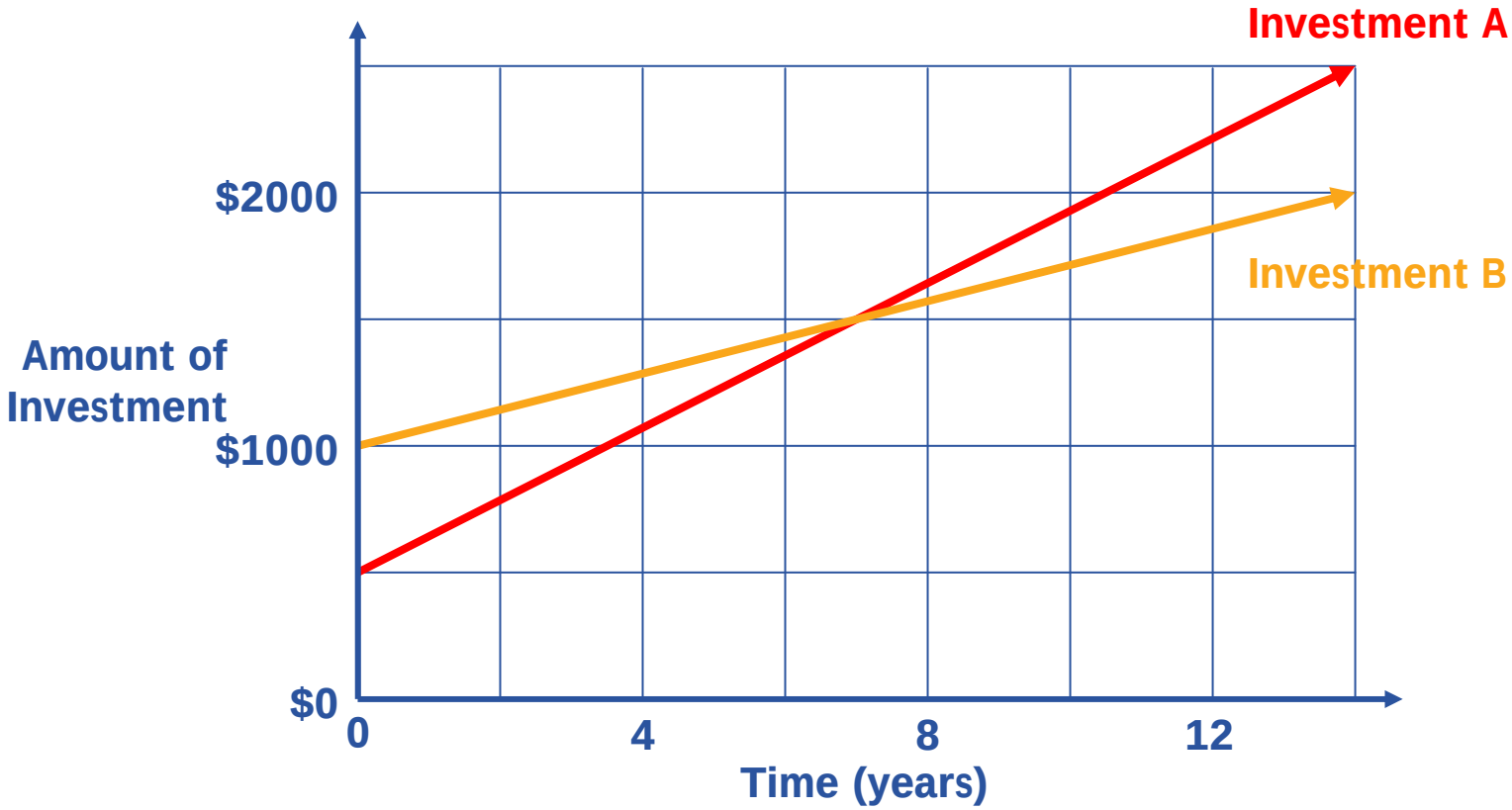
(4)



(5)

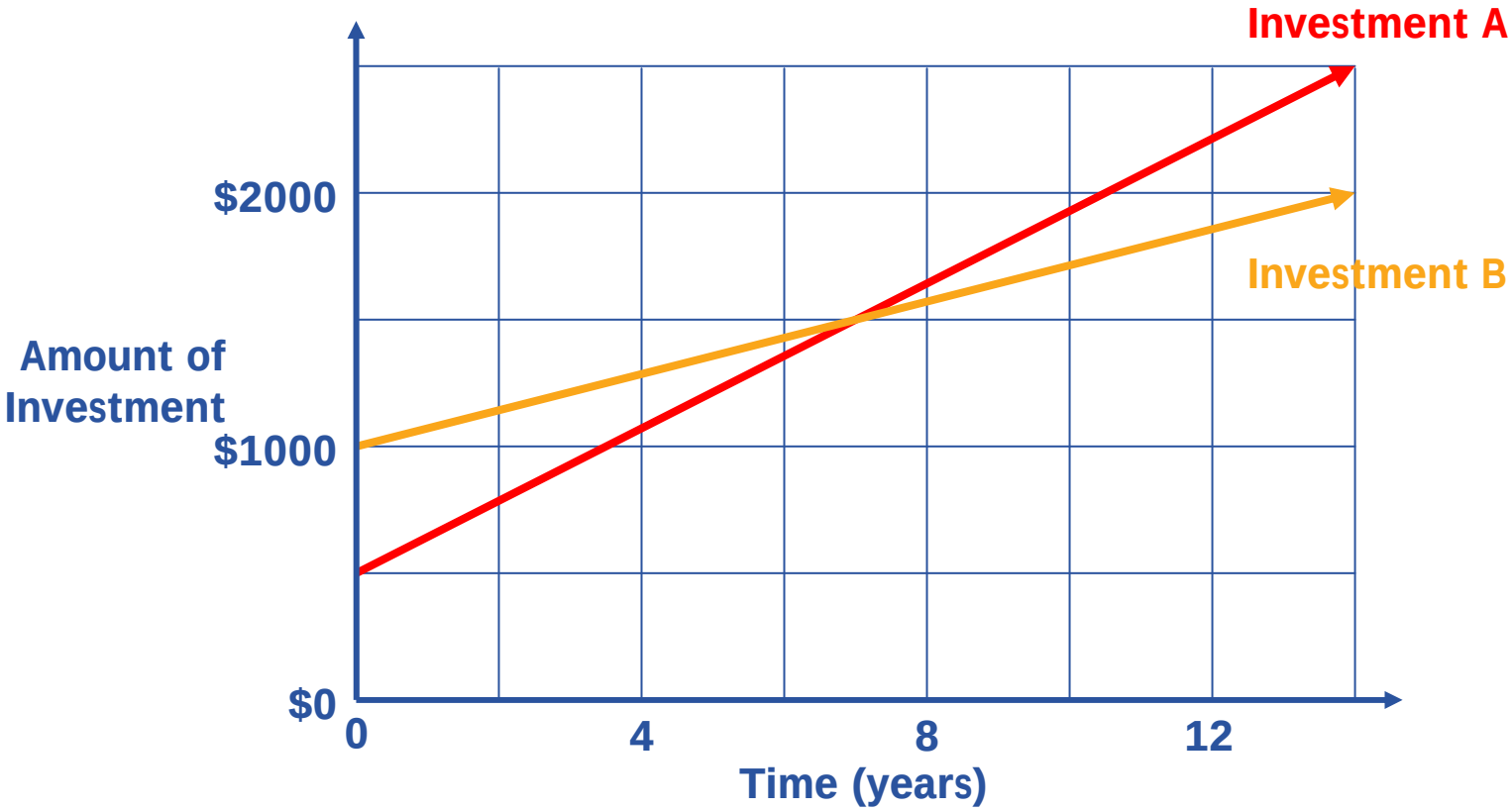
Most Missed Questions: Reading and Interpreting Graphs and Tables

The changing values of two investments are shown in the graph below.

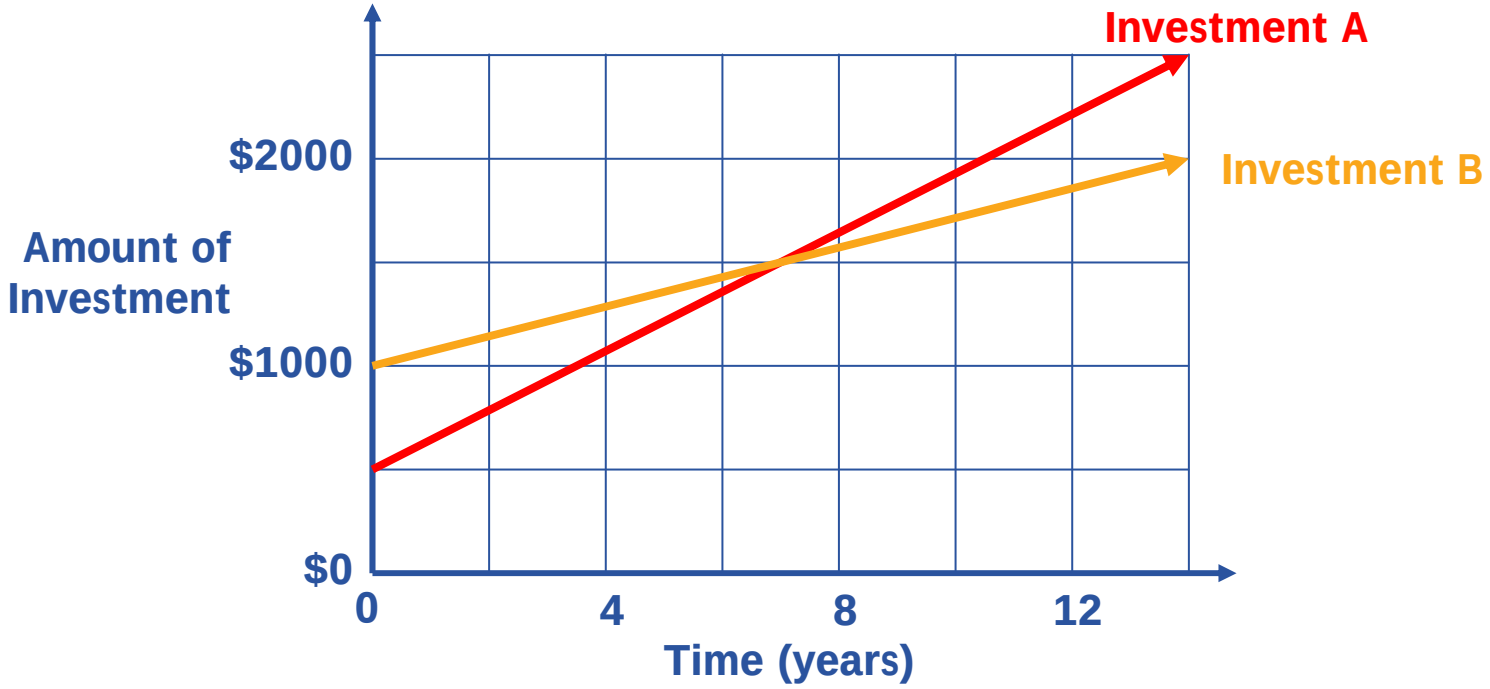


Most Missed Questions: Reading and Interpreting Graphs and Tables

How does the amount initially invested and the rate of increase for investment A compare with those of investment B?



Most Missed Questions: Reading and Interpreting Graphs and Tables



Compared to investment B, investment A had a

(1) lesser initial investment and a lesser rate of increase.

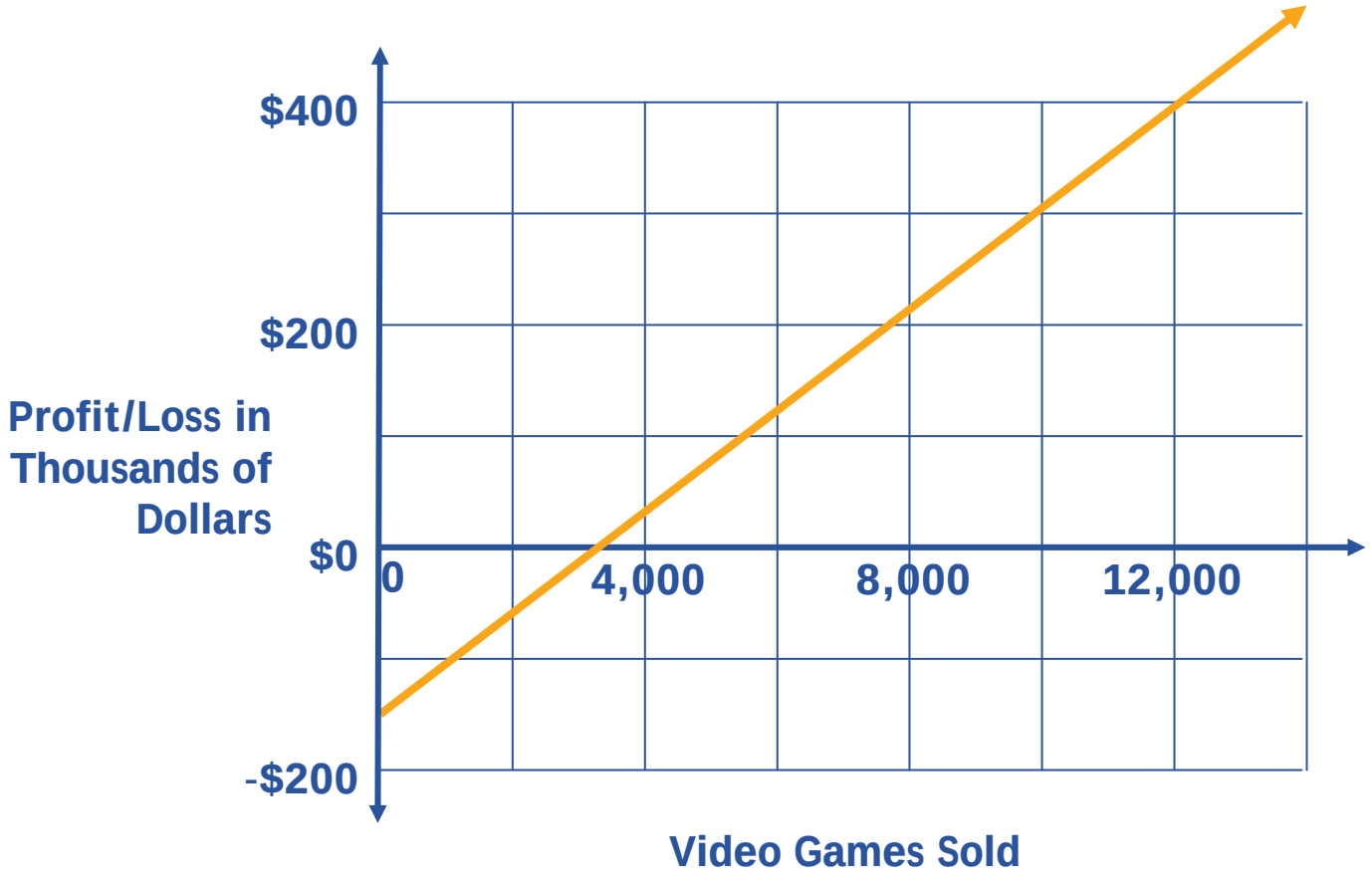
(2) lesser initial investment and the same rate of increase.

(3) lesser initial investment and a greater rate of increase.

(4) greater initial investment and a lesser rate of increase.

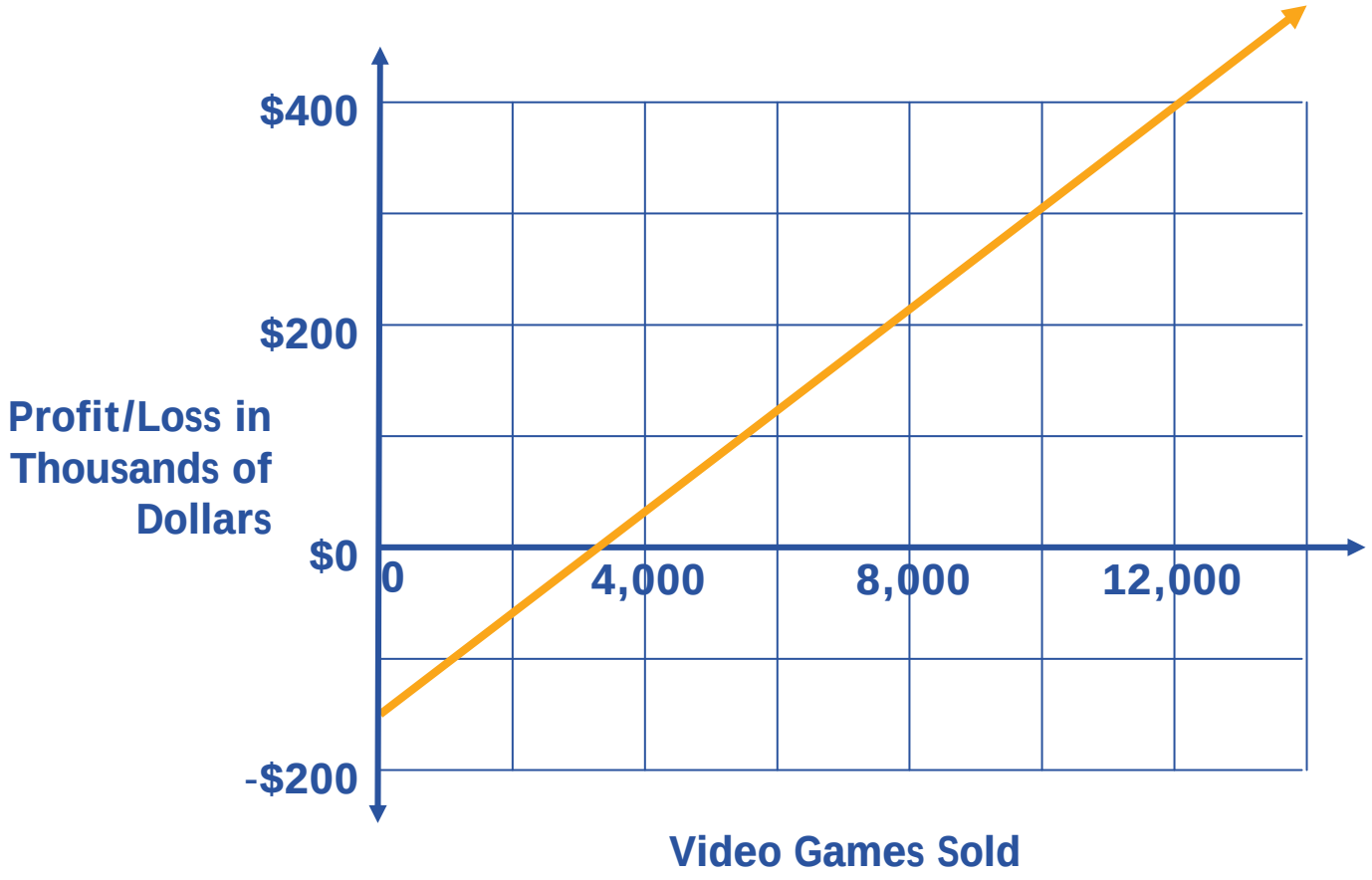
(5) greater initial investment and a greater rate of increase.

Most Missed Questions: Reading and Interpreting Graphs and Tables



The profit, in thousands of dollars, that a company expects to make from the sale of a new video game is shown in the graph.

Most Missed Questions: Reading and Interpreting Graphs and Tables



What is the expected profit/loss before any video games are sold?

(1) $0 (2) -$150 (3) -$250 (4) -$150,000 (5) -$250,000

Most Missed Questions: Reading and Interpreting Graphs and Tables

Results of Internet Purchase Survey

Number of Purchases	Number of Respondents
0	14
1	22
2	39
3	25

What was the total number of internet purchases made by the survey respondents?

(1) 86 (2) 100 (3) 106 (4) 175 (5) 189

$(0 \times 14) + 1 \times 22 + 2 \times 39 + 3 \times 25 = 22 + 78 + 75 = 175$

Most Missed Questions: Reading and Interpreting Graphs and Tables

Claude is sewing 3 dresses in style B using fabric that is 54 inches wide. The table below contains information for determining the yards of fabric needed.

Yardage Information

Dress Size		10	12	14	16
Style A		Yards of Fabric Needed			
Fabric Width	35 in	3.25	3.875	3.875	3.875
	45 in	3	3	3.25	3.25
	54 in	2.375	2.5	2.75	2.75
	60 in	2.25	2.25	2.25	2.5
Style B		Yards of Fabric Needed			
Fabric Width	35 in	3.875	4	4.125	4.625
	45 in	3.125	3.25	3.25	3.625
	54 in	2.5	2.875	3	3
	60 in	2.25	2.375	2.5	2.75

Most Missed Questions: Reading and Interpreting Graphs and Tables

What is the minimum number of yards of fabric recommended for one dress each of size 10, 12, and 14?

Yardage Information

Dress Size+		10	12	14	16
Style A		Yards of Fabric Needed			
Fabric Width	35 in	3.25	3.875	3.875	3.875
	45 in	3	3	3.25	3.25
	54 in	2.375	2.5	2.75	2.75
	60 in	2.25	2.25	2.25	2.5
Style B		Yards of Fabric Needed			
Fabric Width	35 in	3.875	4	4.125	4.625
	45 in	3.125	3.25	3.25	3.625
	54 in	2.5	2.875	3	3
	60 in	2.25	2.375	2.5	2.75

Most Missed Questions: Reading and Interpreting Graphs and Tables

What is the minimum number of yards of fabric recommended for one dress each of size 10, 12, and 14?

Yardage Information

Dress Size		10	12	14	16
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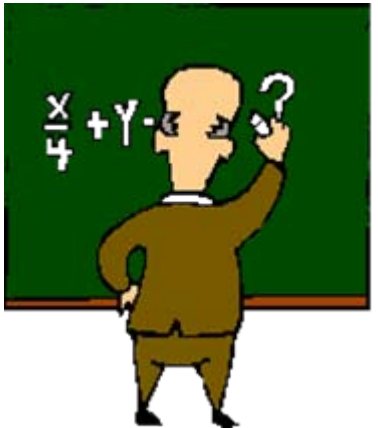
	45 in	3	3	3.25	3.25
	54 in	2.375	2.5	2.75	2.75
	60 in	2.25	2.25	2.25	2.5
Style B		Yards of Fabric Needed			
Fabric Width	35 in	3.875	4	4.125	4.625
	45 in	3.125	3.25	3.25	3.625
	54 in	2.5	2.875	3	3
	60 in	2.25	2.375	2.5	2.75

Teaching Graphic Literacy

Create Your Questions!



Focus on Reading and Interpreting Graphs and Tables

"I hear and I forget. I see and I remember. I do and I understand."

Chinese proverb

Focus on Reading and Interpreting Graphs and Tables

Computer Lab Time!

Activity 1 – Create a Graph!

NCES

http://nces.ed.gov/nceskids/createagraph/

Statistics Canada

http://www.statcan.ca/english/edu/power/ch9/create/create.htm

Charts and Graphs. Educational Resources for Adult

http://www.fodoweb.com/erfora/readtext.asp?txtfile=communications/charts.toc

Handling Data. BBC

http://www.bbc.co.uk/schools/ks2bitesize/maths/handling_data.shtml

Activity 1 – Create a Graph!

Data Sources for Your Graph

U. S. Census Bureau

http://www.census.gov/

Weekly Nielson Ratings

http://www.cnn.com/SHOWBIZ/TV/top10/content.html

FedStats

http://www.fedstats.gov/

Sports Stats

http://sportsillustrated.cnn.com/baseball/mlb/ml/stats/

NFL Stats

http://www.nfl.com/stats/

NBA Stats

http://aol.nba.com/statistics/index.html

Let's Take a Trip!

Activity 2 – Preview a WebQuest

http://fc.portage.k12.wi.us/~caulumj/lesson1.html

http://ib005.k12.sd.us/Excel%20WebQuest/charts_and_graphs.htm

http://www.bhsonline.org/teachers/dube/patswebquest.htm#Process%20for%20Activity%201,%20Task

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http://www.bhsonline.org/teachers/dube/patswebquest.htm#Process%20for%20Activity%201,%20Task

Activity 3: Plot the Coordinates!

Plot the coordinates on the grid using the following website. What letters did you create?

http://www.shodor.org/interactivate/activities/simpleplot/

Make a letter or shape with the coordinates. Give the person next to you the coordinates. See if they plot the coordinates accurately to obtain the correct letter or shape.

Activity 3: Let's Play a Game!

- **Bug Game**
  http://pbskids.org/cyberchase/games/bargraphs/bargraphs.html
- **Coordinates Game**
- http://www.shodor.org/interactivate/activities/GeneralCoordinates/

Activity 5: Explore

Take a Look at the Webquests

- **Charts and Graphs**
  http://fc.portage.k12.wi.us/~caulumj/lesson1.html
- **Charts and Graphs**
  http://ib005.k12.sd.us/Excel%20WebQuest/charts_and_graphs.htm

It's All About Graphs

- **BBC Skillswise**
  http://www.bbc.co.uk/skillswise/numbers/handlingdata/graphs_and_charts/index.shtml
- **Charts and Graphs**
  http://42explore.com/graphs.htm
- **Learning Resources**
  http://www.statcan.ca/english/edu/power/ch9/first9.htm

Creating Graphs

- **Create a Graph NCES**
  http://nces.ed.gov/nceskids/graphing/index.asp
- **Education Resources for Adults**
  http://www.fodoweb.com/erfora/readtext.asp?txtfile=communications/charts.toc

Sample Sites for Data for the Classroom

- **U. S. Census Bureau** http://www.census.gov/
- **Weekly Nielson Ratings** http://www.cnn.com/SHOWBIZ/TV/top10/content.html
- **FedStats** http://www.fedstats.gov/
- **Sports Stats** http://sportsillustrated.cnn.com/baseball/mlb/ml/stats/
- **NFL Stats** http://www.nfl.com/stats/
- **NBA Stats** http://aol.nba.com/statistics/index.html

Tips from GEDTS: Reading and Interpreting Graphs and Tables

- Have candidates find examples of different types of graphs.
- Have candidates create questions for their graphics and/or those of others.
- Develop the capacity to translate from graphics to text as well as text to graphics.
- Develop the capacity to select pertinent information from the information presented.
- Reinforce the need to read and interpret scales, present graphs without scales or without units.

Kenn Pendleton, GEDTS Math Specialist

Final Tips

- Candidates do not all learn in the same manner. Presenting alternate ways of approaching the solution to questions during instruction will tap more of the abilities that the candidates possess and provide increased opportunities for the candidates to be successful.

- After the full range of instruction has been covered, consider revisiting the area of graphics once again before the candidates take the test.

Focus on Reading and Interpreting Graphs and Tables

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