Unit 5:

Statistics

Introduction and Vocabulary

The word *graph* comes from a Greek word meaning *to write or draw.*

Graphs are a special type of drawing or picture showing how numbers relate to each other. Graphs are a convenient way to organize numbers. You may know the old saying, "One picture is worth a thousand words." Graphs give us a general picture of the information to look at first. The details of the information can then be read from the graph.
In this unit you will practice reading five types of graphs: line graphs, bar graphs, histograms, picture graphs, and circle graphs. You will also learn about reading charts and tables.

Study this vocabulary:

Axis An axis is any straight line used for measuring or as a reference. In graphs, we talk about two axes (axes is the plural of axis).

The **horizontal axis** goes across the page. (You will learn in later math courses that the horizontal axis is the **x axis.)**

The **vertical axis** goes up and down the page. (The vertical axis is the **y axis.)**

A trick to remember the difference between horizontal and vertical:

- The horizon is that line of earth you see as you look out at a view:

- The word **horizontal** comes from the root word **horizon**. The horizon goes from left to right, so does the horizontal line in a graph.
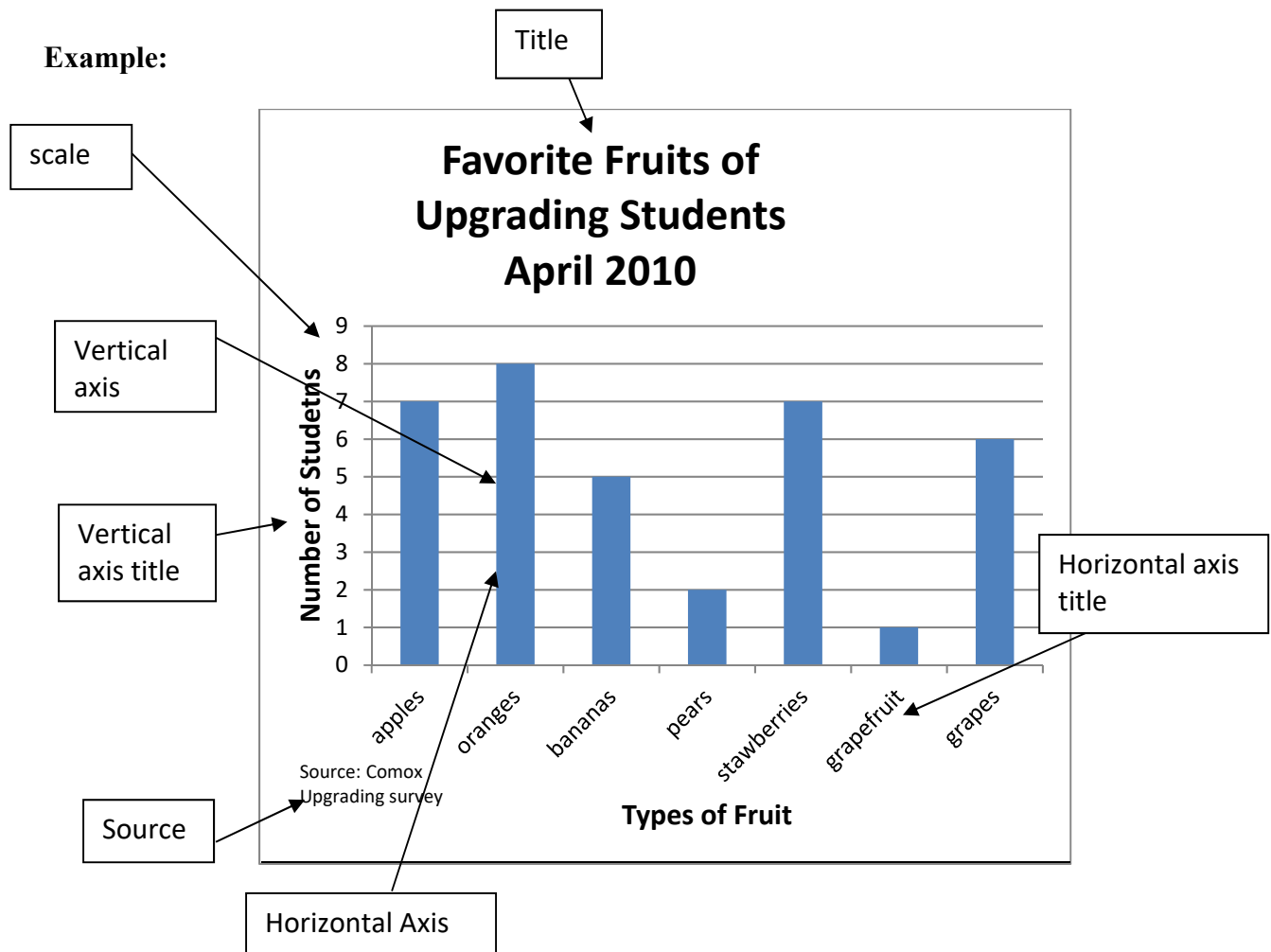
Titles Titles of a graph give important information about the graph and often tell more about what the scale means.

Scale Each axis has a scale. The scale is a series of numbers; beside or below the numbers will be a few words telling what the numbers represent. The numbers we want to place on the graph can be read from the scales. The horizontal scale describes the positions on the horizontal (x) axis. The vertical scale describes the positions on the vertical (y) axis.

Source Graphs often give information that has been collected from other reports or publications. The *source* of the information should be written under the graph. Knowing where the information has come from helps you decide the accuracy of the information in the graph.

Trend The trend is the general direction of events, the general idea of changes that are occurring. For example, there is an upward trend in the cost of houses.

Example:

Title

scale

Vertical axis

Vertical axis title

Horizontal axis title

Favorite Fruits of Upgrading Students April 2010

Number of Studetns

apples oranges bananas pears stawberries grapefruit grapes

Source: Comox Upgrading survey

Types of Fruit
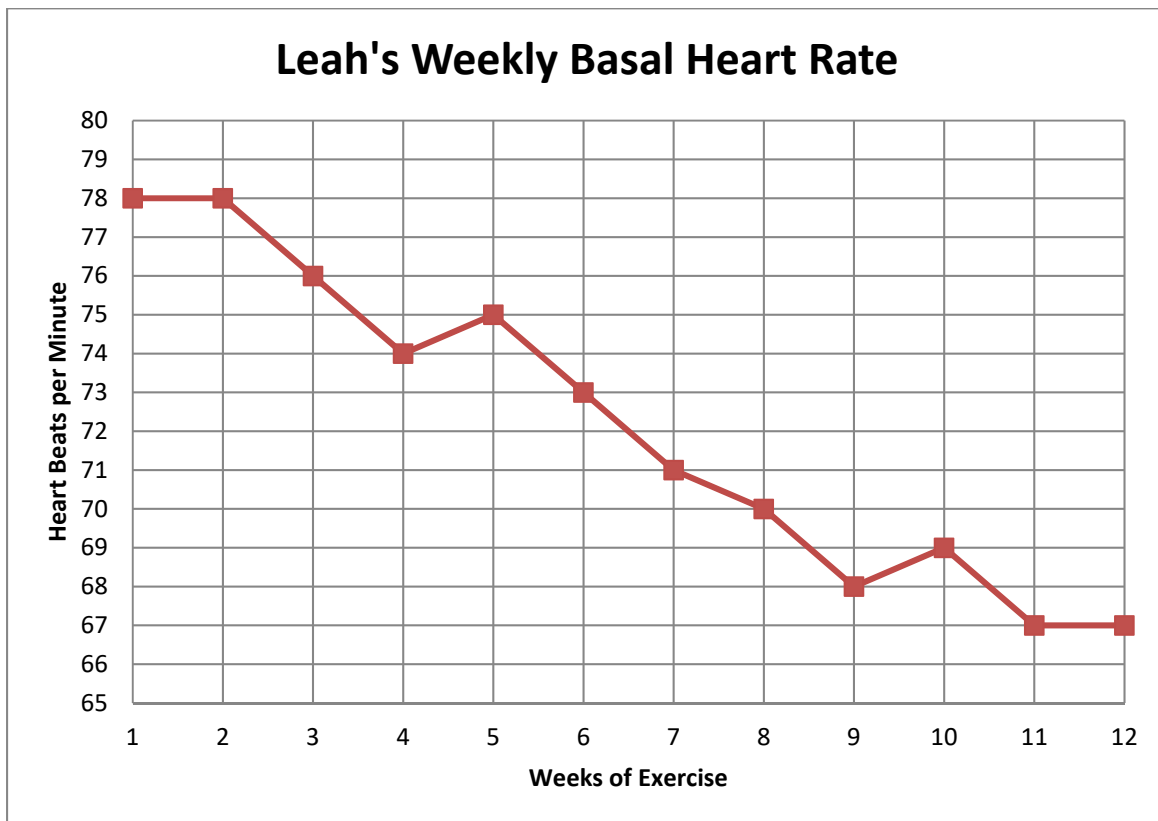
Source

Horizontal Axis

Note: Graphs should always have 0 as the first number on both axes. In this book, there are several graphs that begin at the wrong point. The ability of the Microsoft Excel program used to create these graphs does not allow for creating a special "break" that should be used in situations like in graph 1, 2, & 3 where there would be a lot of wasted space in the graph. If you would like to know more about this issue, please talk to your instructor.

Topic A: Line Graphs

Line graphs are used to show **changes that happen over a period of time.** Line graphs easily show trends and patterns.

The most common way to set up a line graph is to put **time** on the horizontal (x) axis. Whatever is being measured is then put on the vertical (y) axis.

Graph One

Leah's Weekly Basal Heart Rate

Heart Beats per Minute (y-axis, from 65 to 80)

Weeks of Exercise (x-axis, from 1 to 12)

Data points: Week 1: 78, Week 2: 78, Week 3: 76, Week 4: 74, Week 5: 75, Week 6: 73, Week 7: 71, Week 8: 70, Week 9: 68, Week 10: 69, Week 11: 67, Week 12: 67

Leah has taken up cycling and jogging to improve her cardiovascular fitness and for weight control. She takes her pulse every Monday morning before she gets out of bed; that is her basal heart rate. Graph One records Leah's heart rate for the first 12 weeks of her exercise program.

a) What is the title of the graph?

_____

b) What is being measured on the vertical axis?

_____

On this particular graph the **vertical scale** is one heartbeat per line. The scale on the **horizontal axis** is one week per line.

c) What was Leah's basal heart rate on the fourth week of her exercise program?

- Find Week 4 on the horizontal (x) axis.

- Look straight up from Week 4 until you come to the point in the graphed line.

- Now look at the scale on the vertical (y) axis. Lay a ruler or straight piece of paper across the graph to help you read the scale at the point for Week 4.

Leah's basal heart rate was 74 beats/min in week four.

d) Find her basal heart rate in Week 7.

_____

e) What does the graph show us happened between Week 9 and Week 10?

_____

f) What **trend** does this graph show?

The graph shows Leah's basal heart rate is "going down" or decreasing.

Often, you need to estimate the value of the point in the graphed line. Look at Graph Two which has Leah's same heart rates recorded.

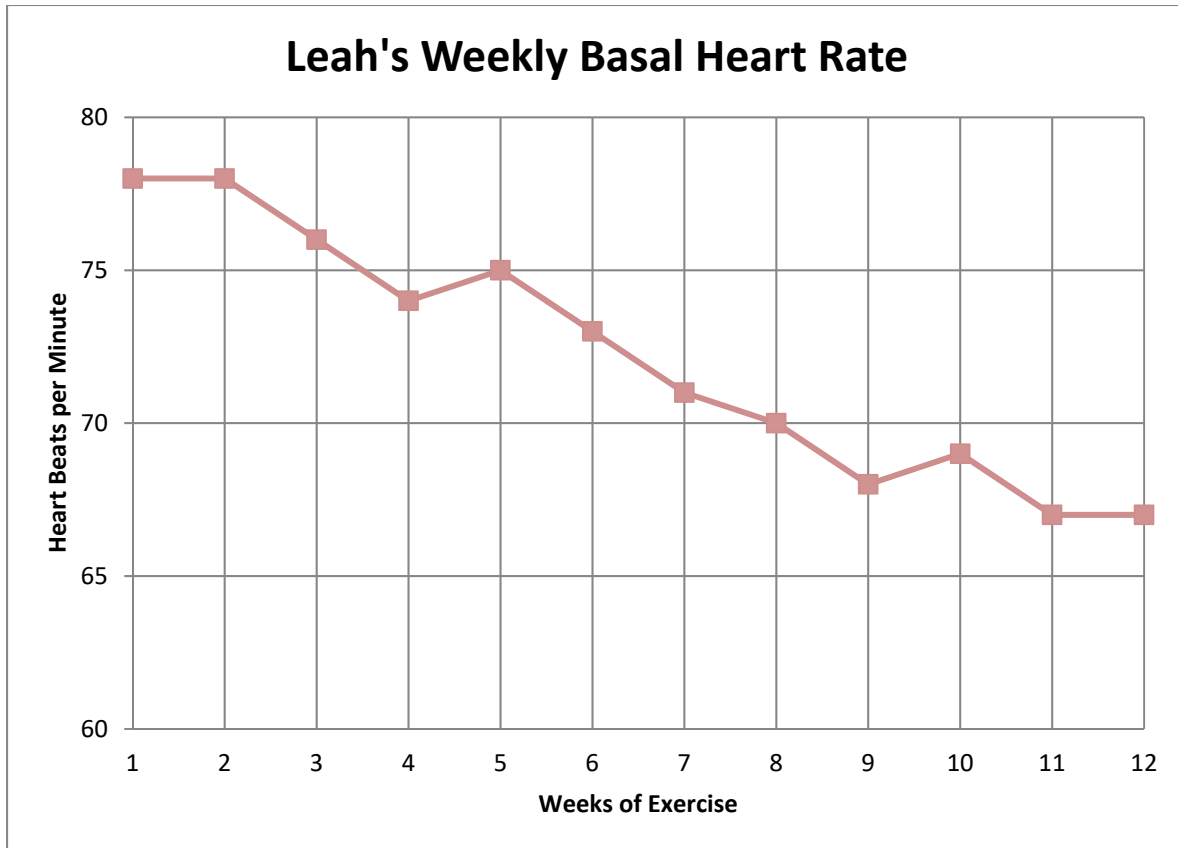**Answers to Graph One**
a) Leah's Weekly Basal Heart Rate   b) Heart beats per minute   c) given: 74 beats/min
d) 71 beats/min   e) Leah's heart rate went <u>up</u> from 68 to 69 beats/min

Graph Two

Leah's Weekly Basal Heart Rate

Now the scale on the vertical axis is **five** heartbeats per line. Use a straightedge (ruler or paper) across the graph to help you read the vertical scale.

a) Give Leah's heart rate in Week 5. _____

b) Give Leah's heart rate in Week 10. _____

c) What was Leah's heart rate in Week 12? _____

d) Using the information on the graphs, tell how much Leah's basal heart rate decreased (in beats per minute) from Week 1 to Week 12. _____
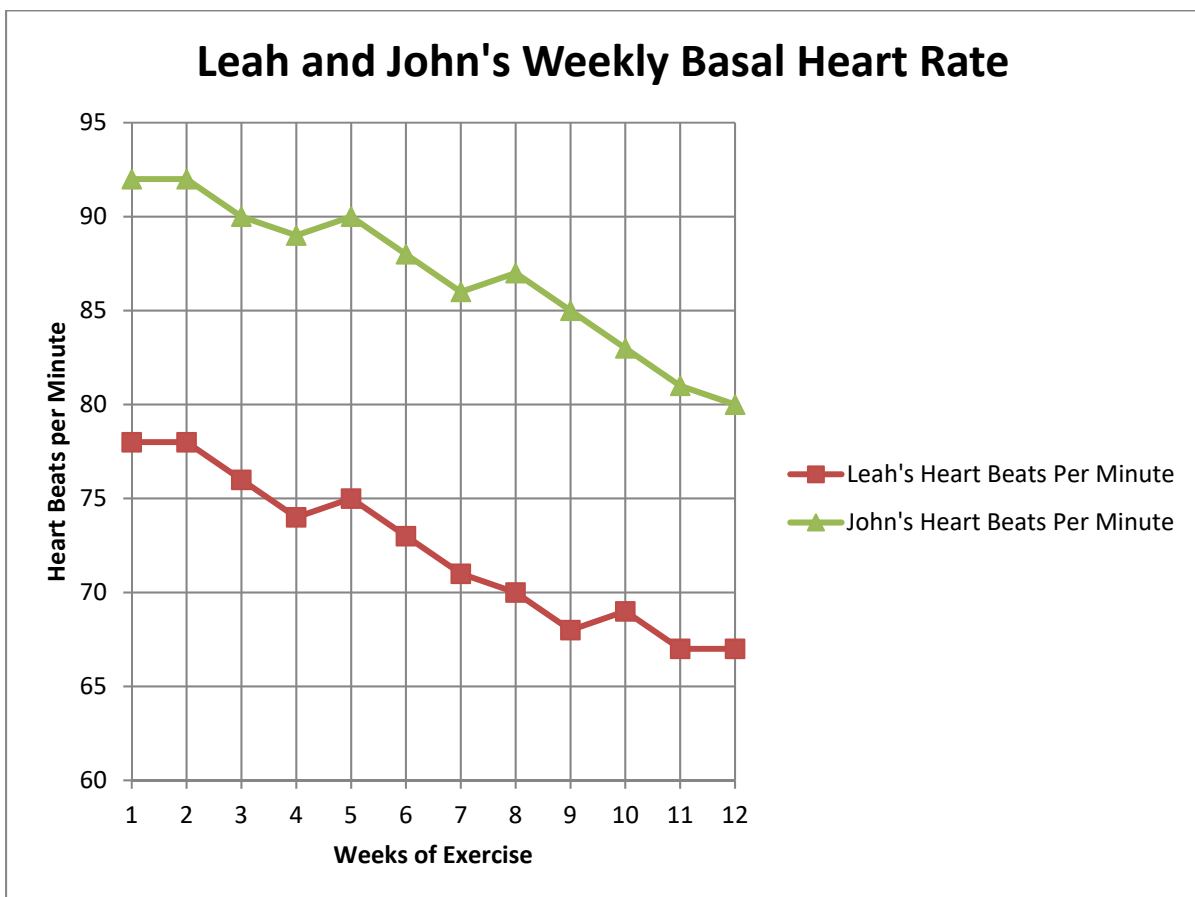
Answers to Graph Two
a) 75 beats/min   b)   69 beats/min   c)   67 beats/min
d) decreased 11 beats/min (78 – 67 = 11)

The person drawing a graph decides how to label it and how to write the scale on the axes depending on the information to be shown on the graph. The graphs about Leah focus on the range of **her** heart rate. There is no need to make the heart rate scale lower than 55 or higher than 80 for Leah.

Graphs often show information about several things on the same graph. Such graphs are very useful for making comparisons. Look for a **legend** or **key** that explains what each graphed line represents. The legend may be printed right by the graphed information or it may be beside or below the graph.

Graph Three

Leah's husband John decided he would exercise as well. He had a rapid heart rate at the beginning of the exercise program. Since his heart rate is higher than 85, we must increase the numbers on the vertical scale so we can graph John's heart rate on the same graph as Leah's.

Leah and John's Weekly Basal Heart Rate

Heart Beats per Minute

- ■ Leah's Heart Beats Per Minute
- ▲ John's Heart Beats Per Minute

Weeks of Exercise

a) What was John's heart rate in Week 6? _____

b) What was John's heart rate in Week 10? _____

c) How much lower was Leah's heart rate than John's in Week 8?

_____

d) How much did John's heart rate drop in the 12-week exercise program?

_____

e) What was the amount of change in John's heart rate between Week 3 and Week 7? Was it an increase (+) or decrease (-)?

_____

f) Compare the two graphed lines.

   i) How is the slant of the lines different? _____

     _____

   ii) How are the lines the same? _____

     _____

   iii) You can tell from looking at this graph that John and Leah had a similar trend in the change in their basal heart rates. Did their heart rates increase or decrease? _____
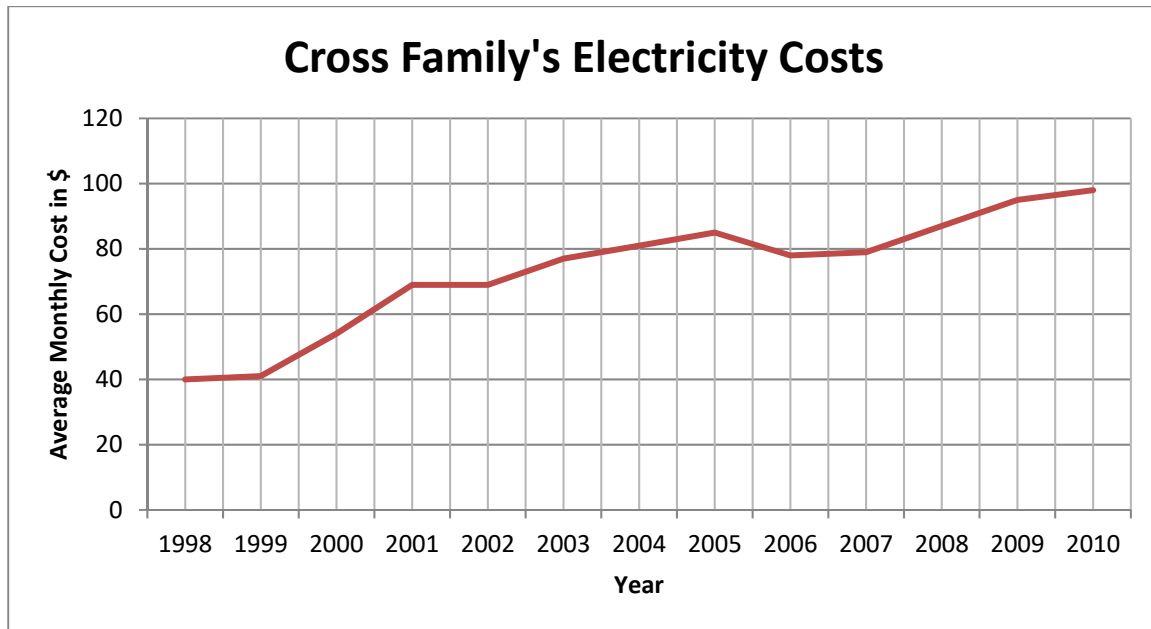
If the graphed lines have about the same slant, the **rate of change** is the same for the information being graphed. By looking at graphed lines you can tell if one has increased or decreased more quickly. You can easily compare changes and tell when the changes occurred.

**Steps to Follow When Reading Line Graphs
With Two Types of Information**

1. Read all the titles so you know what the graph is about.

2. Look at the information on the vertical and horizontal scales.

3. Decide what the graphed lines represent. Look for a legend and be sure you know which line is which.

4. Interpret (read) the information on the graph.
   - First get a general look at what is on the graph.
   - Second, look for the detailed information that you need.

Graph Four

Cross Family's Electricity Costs

(Graph: Average Monthly Cost in $ vs Year, 1998–2010. The line begins around $40 in 1998 and 1999, rises to about $69 in 2001, continues to about $85 in 2005, dips to about $78 in 2006–2007, then rises to about $98 in 2010.)

a) What is the general trend in the Cross's average monthly cost for electricity?

_____

b) What was the average monthly cost of electricity in 1998? _____

c) How much more did they pay per month in 2003 than in 2000?

_____

d) What happened to the average cost between 2005 and 2006?

_____

e) By how much did the Cross's average monthly electricity cost increase between 1998 and 2010? _____

Answers to Graph Four

a) increased	b) $40	c) Approximately $23 ($77 – 54)
d) decreased	e) $59	

Line graphs can also be used to graph two different types of related information on the same chart. For example, we may have wanted to put Leah and John's weight changes and heart rate changes on the same graph.

When we graph different types of information,

- A sub-title usually explains the two types of information (written in smaller print under the title).

- The horizontal axis is the same.

- The vertical axis on the **right** side of the graph has the scale for the second set of information. For example, on the graph for Leah and John the right vertical axis would be marked in kilograms for weight changes.

**Steps to Follow When Reading Line Graphs
With Two Types of Information**

1. Read the titles and subtitles.

2. Look at the legend to identify the graphed lines and check where the scale for each line is written (on the left or on the right vertical axis).

3. Go up from the horizontal axis in the same way, and read the appropriate scale on the left or right vertical axis for each graphed line.

Graph Five

Cross Family's Electricity Costs
Average Cost/Month and Annual Kilowatt Hours (kWh) Used
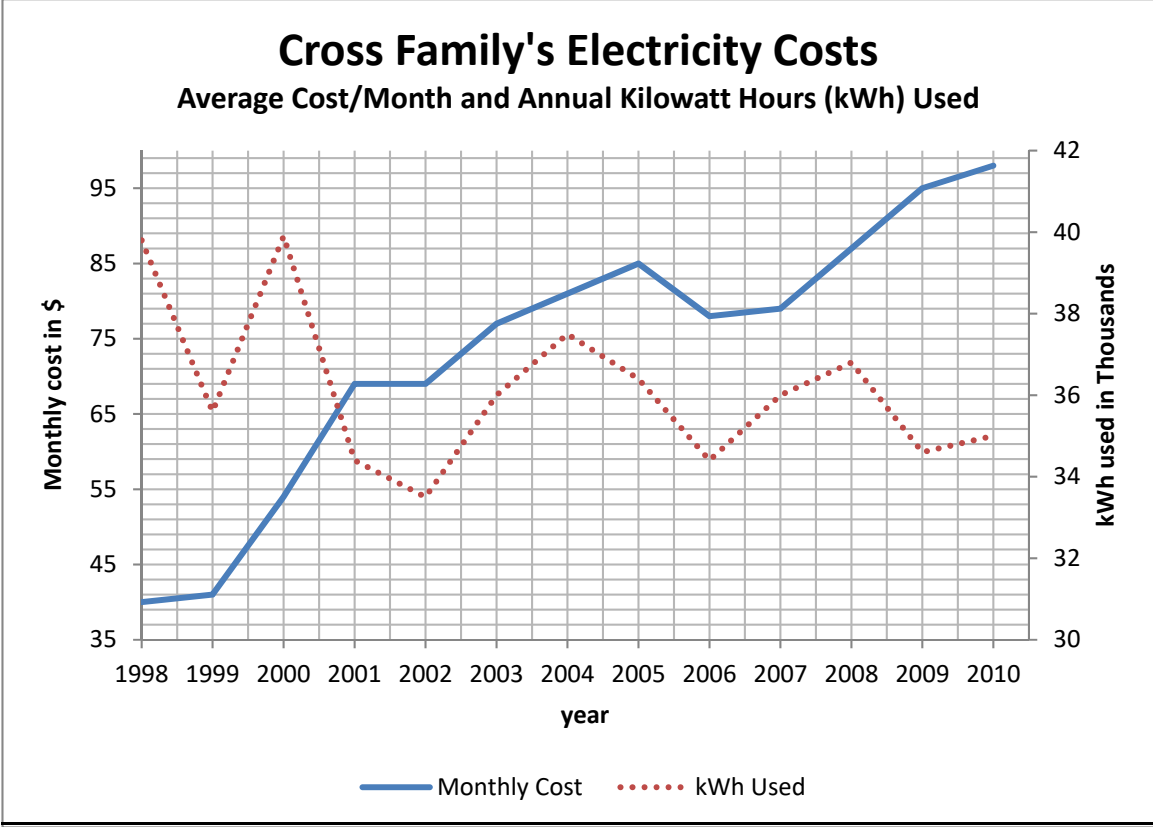
a) What is the title of this graph? _____

b) What is the subtitle? _____

c) Look at the legend. What does the graphed line for "Kilowatt Hours Used" look like?

   _____

d) Where is the scale for kilowatt hours? _____

e) How is the scale for kilowatt hours labeled? _____

> *in thousands* means that each figure in the scale is to be multiplied by 1 000.
>
> 32 means 32 000

f) Which two years was the use of kWh the greatest? _____

g) When was the use of kWh the least? _____

h) Look at 1999 and 2000.

i) Find the amount of kWh used (in thousands) in 1999 _____ and the cost of electricity in 1999 _____ .

   ii) Compare to the amount of kWh used in 2000 _____ and the cost of electricity in 2000 _____ .

   iii) What can you conclude by comparing the cost and the kWh use in 1999 and 2000?

   _____

i) Now look at 2001 and 2002.

   i) Compare the use of kWh's.   2001 _____ 2002 _____ .

   ii) Compare the cost.   2001 _____ 2002 _____ .

   iii) What can you conclude? _____

j) Between 2009 and 2010 the use of kWh went *up or down*? by _____ kWh.

The cost of electricity went *up or down*? by $ _____ .

Answers to Graph Five

a) Cross Family's Electricity Costs

b) Average Cost/month & Annual Kilowatt Hours Used

c) dotted line   d)   right side of graph   e)   kWh used in thousands

f) 1998 + 2000   g)   2002

h) i) 65 000 kWh and $41.

  ii) 40 000 kWh and $54.

 iii) the price per kWh increased

i)   i) & ii) 2001 $\approx$ 35 000 kWh & $69; 2002 $\approx$ 33 000 kWh & $69

iii)   You can conclude the price/kWh decreased.

j)   The use of kWh went <u>down</u> by 2 000 kWh. Cost went <u>up</u> by $5.

⇨   The steepness of the slant of a graphed line gives you a picture of the **rate of change**. The steeper the slant the greater the change.

This double graph shows that the average monthly cost of electricity has increased while the annual use of kilowatt hours has shown an overall decrease.

Topic A: Self -Test

Mark /7   Aim 6/7

Label all the parts of the following line graph: **7 Marks**

1. Horizontal Axis
2. Vertical Axis
3. Title
4. Scale(s)
5. Source
6. Vertical axis title
7. Horizontal axis title

Number of Births in British Columbia
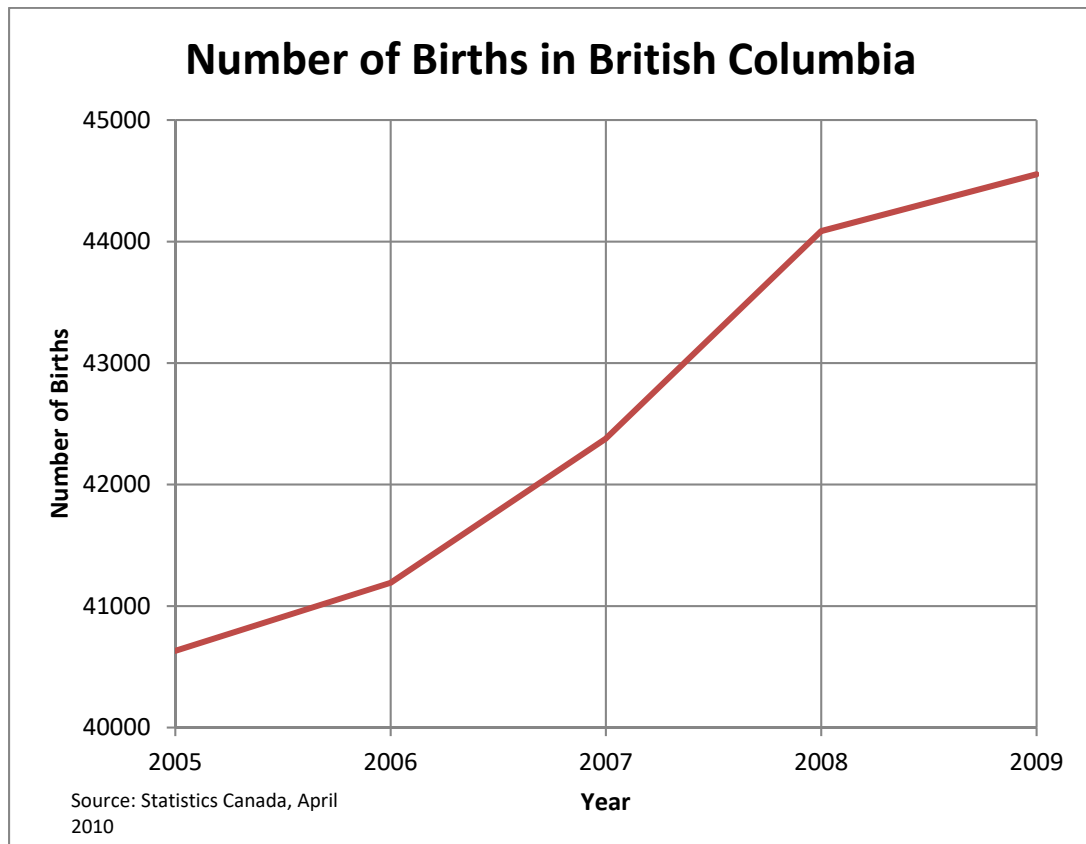
Answer to Self-Test: Go back to the introduction of this unit to check your labeling compared to the example there.

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Topic B: Bar Graphs

Bar graphs **compare quantities**. Bar graphs are commonly used to illustrate information in newspapers, in magazine articles, and so on. Bar graphs may be written with the bars arranged vertically or horizontally. Graph One is shown both ways – first with vertical bars and second with horizontal bars.

Steps To Follow When Reading a Bar Graph:

1. Read the title and subtitles so you know what you are looking at.

2. Read the information on the vertical and horizontal axes. Notice that each bar represents a different item.

3. Look carefully at the scale. What unit of measure is being used? The unit of measure will be the same for each bar so that you can compare them.

4. Compare the length or height of each bar to find the information that you want.

Graph One

Lengths of Some British Columbia Rivers

Lengths of Some British Columbia Rivers
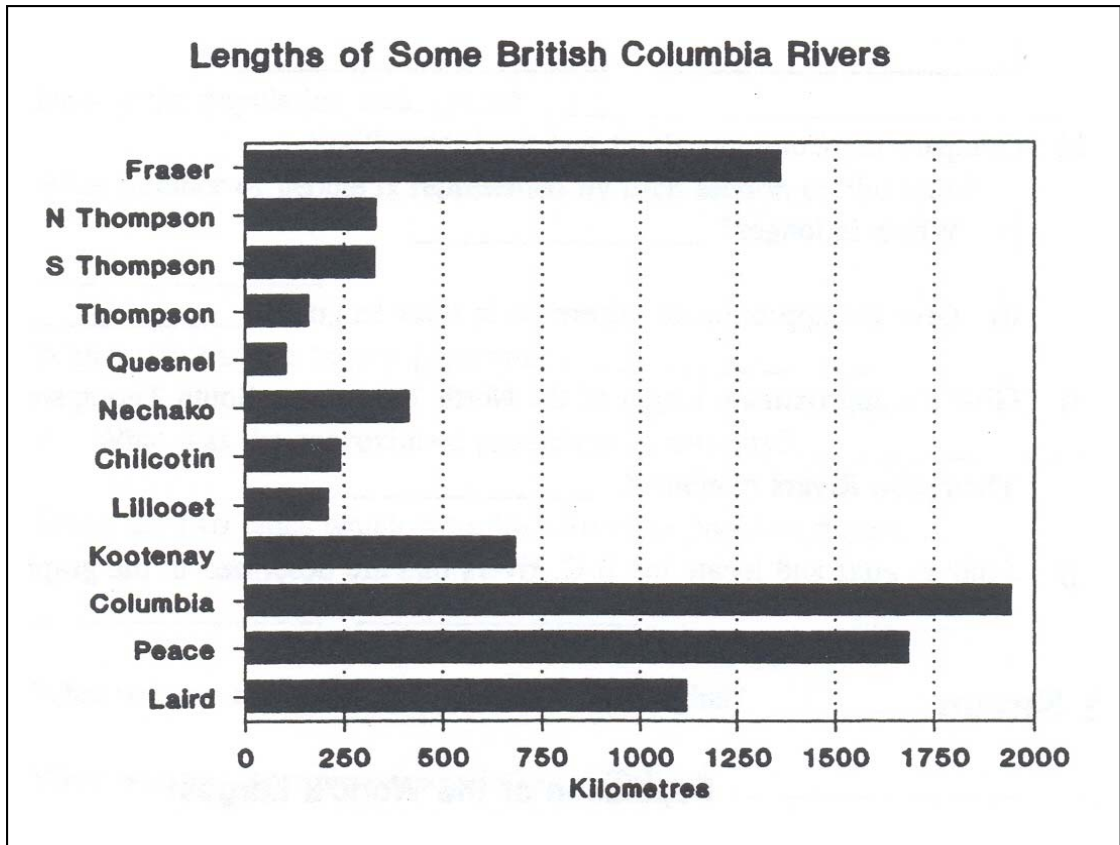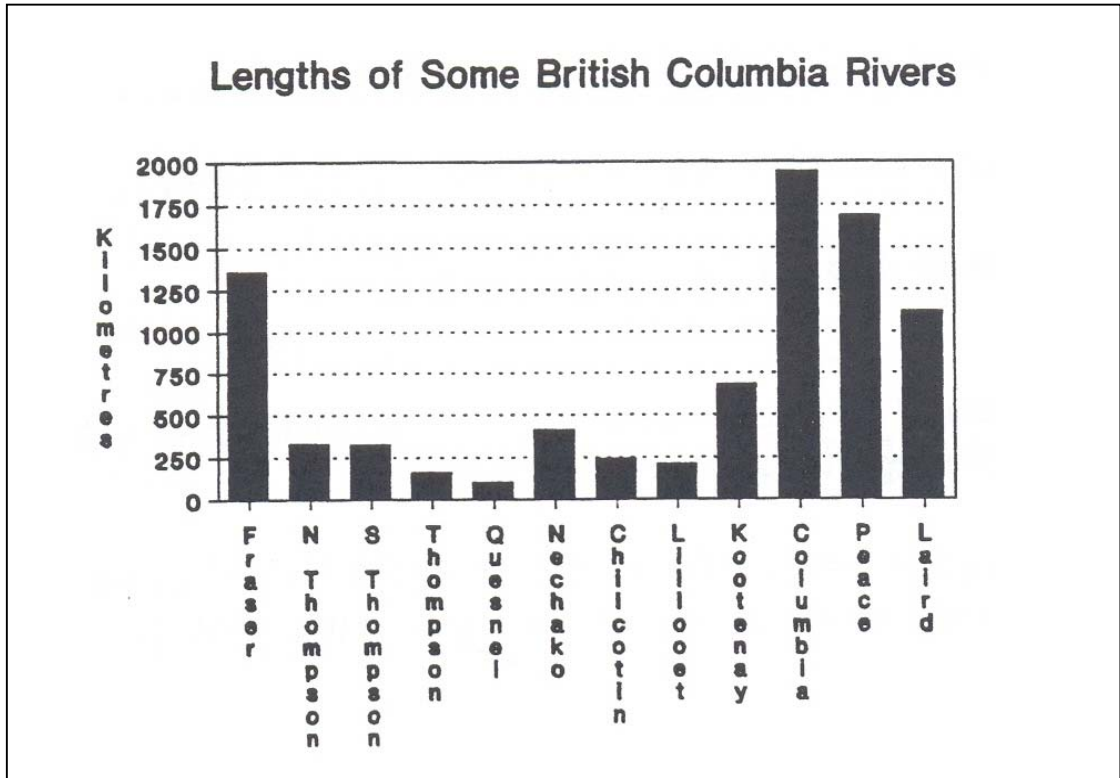
a) How many rivers are shown on this graph? _____

b) What is the title of the graph? _____

c) What is the unit of measure? _____

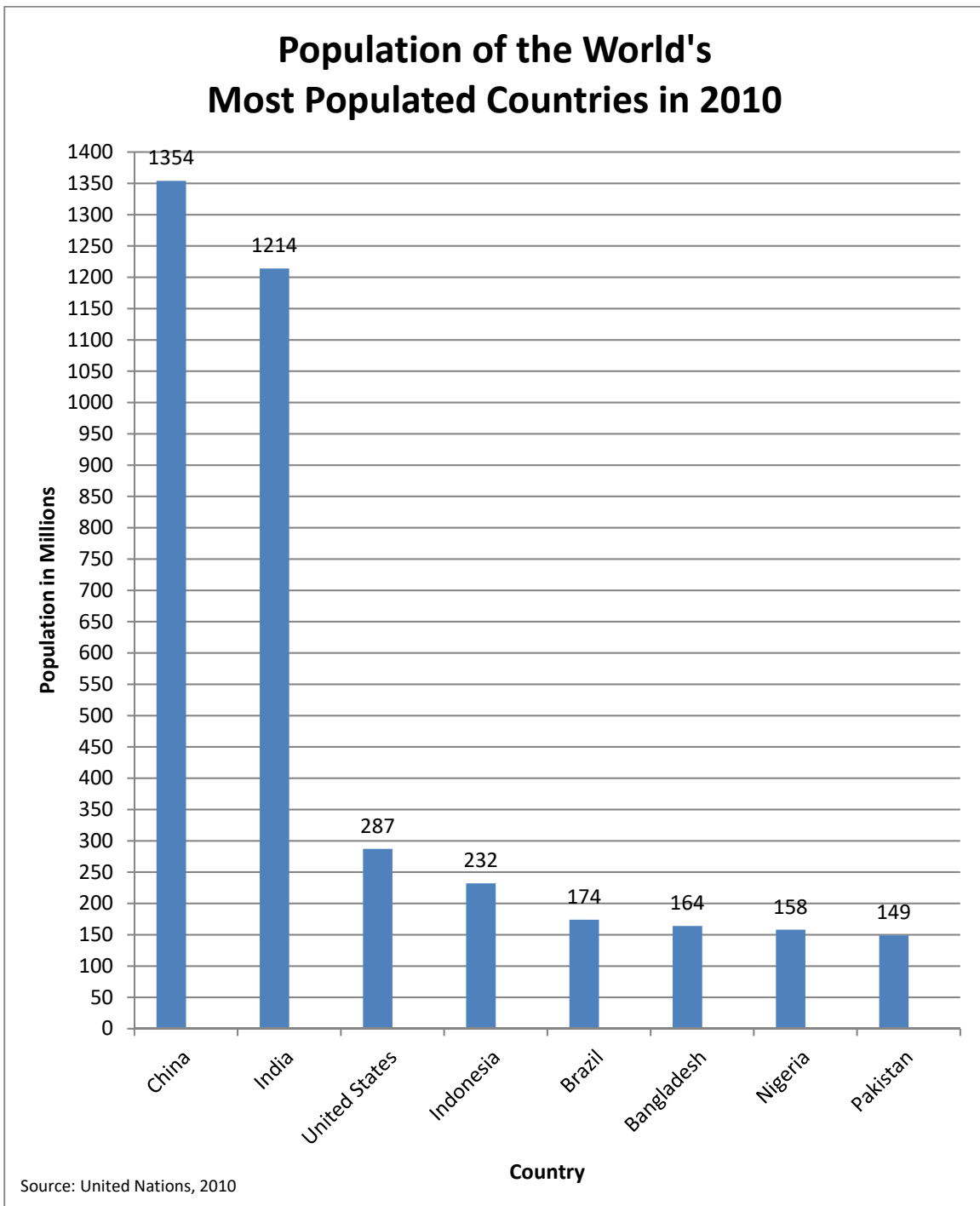d) Look at the scale for kilometres. How many kilometres are represented by each division on the page?

_____

e) Which river is the longest? _____

What is its length? _____

f) Which river is the shortest? _____

What is its length? _____

g) Name two rivers which are approximately the same length.

_____   _____

h) Compare the Columbia River and the Fraser River.

i) Which is the longer? _____

ii) Give the approximate difference in their lengths. _____

i) Give the approximate length of the North Thompson, South Thompson, and Thompson Rivers combined.

_____

Answers to Graph One

a) 12 rivers   b) Lengths of some British Columbia Rivers
c) kilometres   d) 250 km   e) Columbia $\approx$ 1950 km
f) Quesnel $\approx$ 100 km   g) North Thompson & South Thompson
h) Columbia $\approx$ 600 km (1950 – 1350)   i) $\approx$ 750 km

Graph Two

Population of the World's Most Populated Countries in 2010

Country	Population in Millions
China	1354
India	1214
United States	287
Indonesia	232
Brazil	174
Bangladesh	164
Nigeria	158
Pakistan	149

Source: United Nations, 2010

a) Give the source of the information for this graph. _____

b) What is the unit of measure for the population scale? _____

c) What number of people is represented by each section on the scale?

   _____

c) i. Which country had the largest population? _____

   ii. What was the approximate population of this country? _____

e) Name the two countries which were the closest in population size.

   _____   _____

f) What was the approximate population of Bangladesh? _____
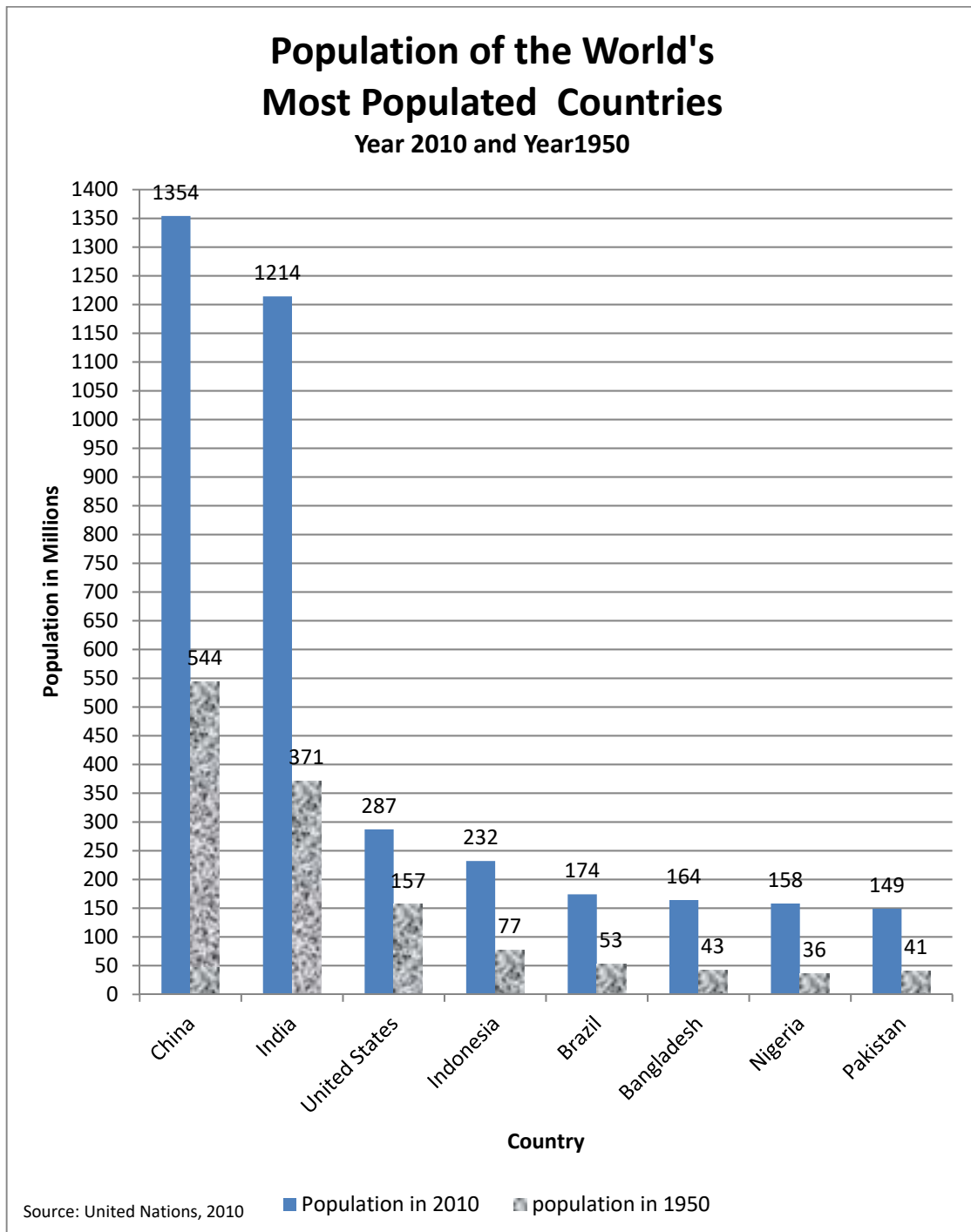
g) What was the approximate population of India? _____

Answers to Graph Two

a) United Nations   b) In the Millions   c) 50 milllion
d) i. China ii. 1 354 000 000   e) Nigeria and Bangladesh
f) 164 000 000   g) 1 214 000 000

➡ Bar graphs can show more than one type of information for each item. These graphs are useful for making comparisons. The bars are usually shaded or coloured differently and a legend will be placed near the graph. The bar graphs must still all use the same unit of measure.

Graph Three

Population of the World's Most Populated Countries

Year 2010 and Year1950

Population in Millions

Country	Population in 2010	population in 1950
China	1354	544
India	1214	371
United States	287	157
Indonesia	232	77
Brazil	174	53
Bangladesh	164	43
Nigeria	158	36
Pakistan	149	41

Source: United Nations, 2010

a) What is the subtitle? _____

b) Look at the legend. The grey bars give each country's population for what year? _____. The patterned bar gives the population

for these same countries in what year? _____

b) What trend does the graph show? _____

d) i. Which country had the largest increase in population? (this means, which
    country's population went up by the highest number) _____

    ii. About how much was that increase? _____

e) i. Which country had the least change in population? _____
       (this means – which country's population went up the least?)

   ii. About how much was that change? _____

Answers to Graph Three

a) Year 2010 and Year 1950
b) 2010, 1950
c) That countries around the world are growing in population
d) i. India   ii. The increase was 843 million
e) i. Pakistan   ii. The increase was 108 million

Topic B: Self-Test

Mark **/4** **Aim 4/4**

The projected population of the world's most populated countries is shown in the following graph. Label all the parts of this graph. **4 Marks**

1. Title
2. Axis title(s)
3. Source
4. Scale

Projected Population for Year 2050

Source: United Nations, 2010
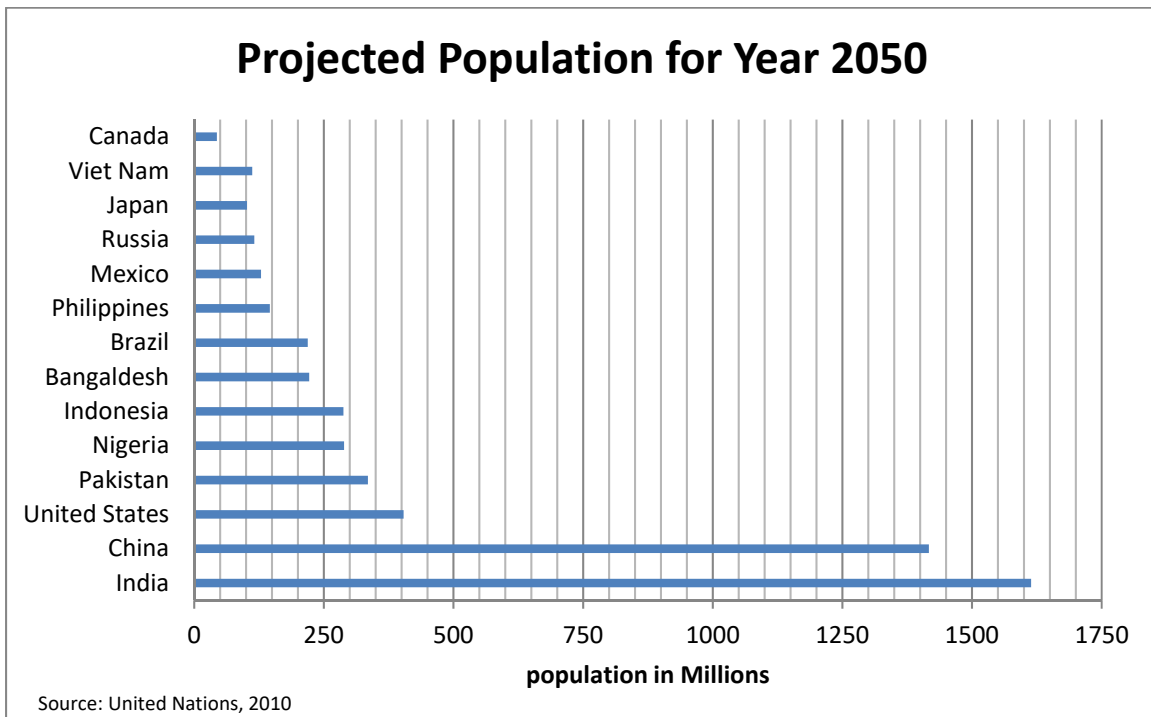
Answer to Self-Test Check your answers against the information in the introduction to make sure you have labeled everything right.

Topic C: Picture Graphs

Picture graphs are similar to bar graphs. **Picture graphs show comparisons between quantities.** A little picture represents a certain amount. Look for the legend to find out that amount. Picture graphs will give fractions of a picture also. For example, if the picture represents 100 things, half a picture would be 50.

Graph One

Informal Survey of Vehicles per 1000
Used in Summer Months

cars

bikes & motorcycles

large trucks

RV's & small trucks

1 picture = 100 vehicles
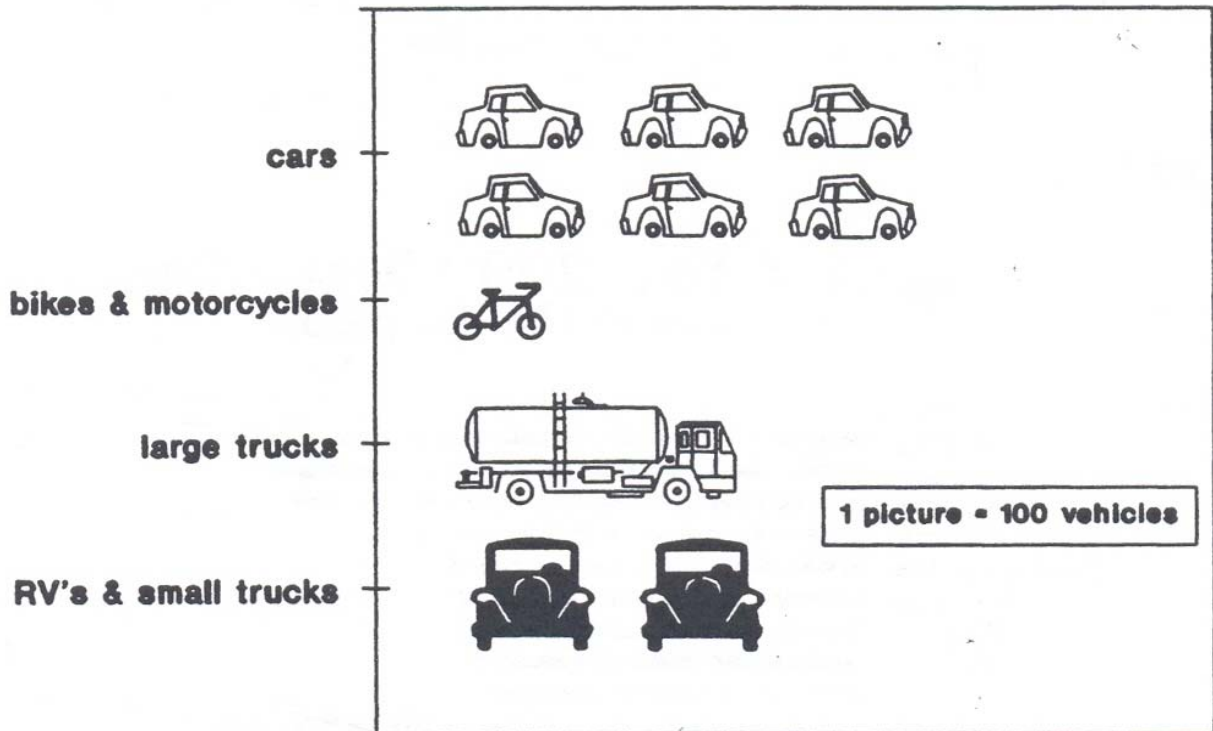
a) As a quick first impression when you look at this graph, which type of vehicle is most in use?

   _____

b) What does each picture represent according to the legend? _____

c) Out of every 1 000 vehicles, how many are:

   i) cars? _____

   ii) bikes and motorcycles? _____

   iii) large trucks? _____

   iv) RVs and small trucks? _____

d) Look for other examples of picture graphs in the newspaper and in magazines. Television programs often display picture graphs to illustrate statistics.

Answers to Graph One
a) car
b) 100 vehicles
c) i) 600   ii) 100   iii) 100   iv) 200
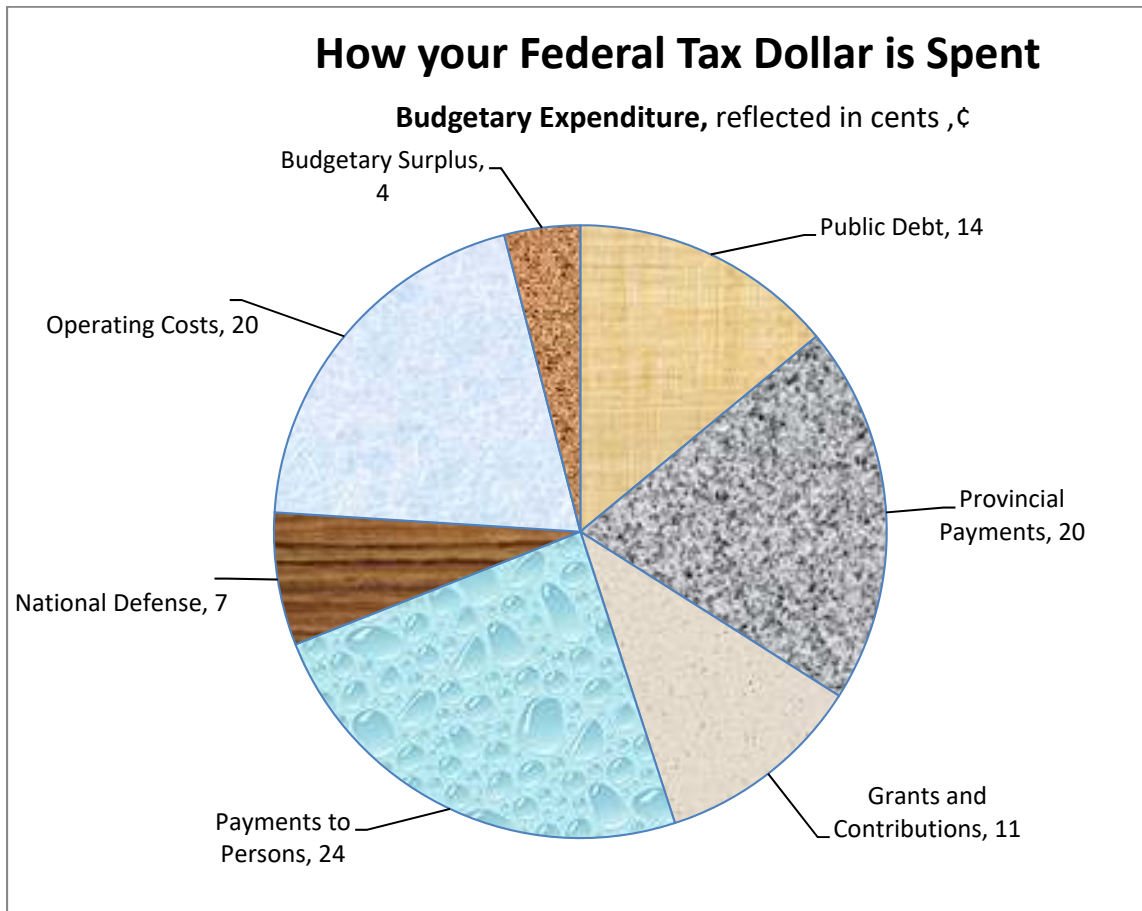

Topic D: Circle Graphs ("Pie Graphs")

Circle graphs **show how the parts of something compare to each other**. Circle graphs also **give a good picture of each part compared to the whole thing**. In a circle graph or pie graph, the complete circle is the whole thing. The parts of a circle graph may be identified with a percentage. The total of the parts must be 100%.

Graph One

The circle represents each dollar the government spends. The information for the graph was found at the Department of Finance, April 2010.

http://www.fin.gc.ca/taxdollar/09/mm-eng.asp

The parts are shown as cents of the dollar.

How your Federal Tax Dollar is Spent

Budgetary Expenditure, reflected in cents ,¢

Budgetary Surplus, 4
Public Debt, 14
Operating Costs, 20
Provincial Payments, 20
National Defense, 7
Grants and Contributions, 11
Payments to Persons, 24

a) What is the biggest expense of the federal government?

_____

> The federal government is the employer of hundreds of thousands of Canadians in the civil service and in the armed forces (defence budget). The *Payments to persons* shown on the graph are social security, family allowance, Canada Pension, employment insurance, and other similar services.

b) How much of each federal dollar is spent in actually operating the government business?

_____

c) What part of the federal dollar is spent on defence? _____

d) How much of each dollar is spent on Provincial Payments?_____

   Write this amount as a percent. _____

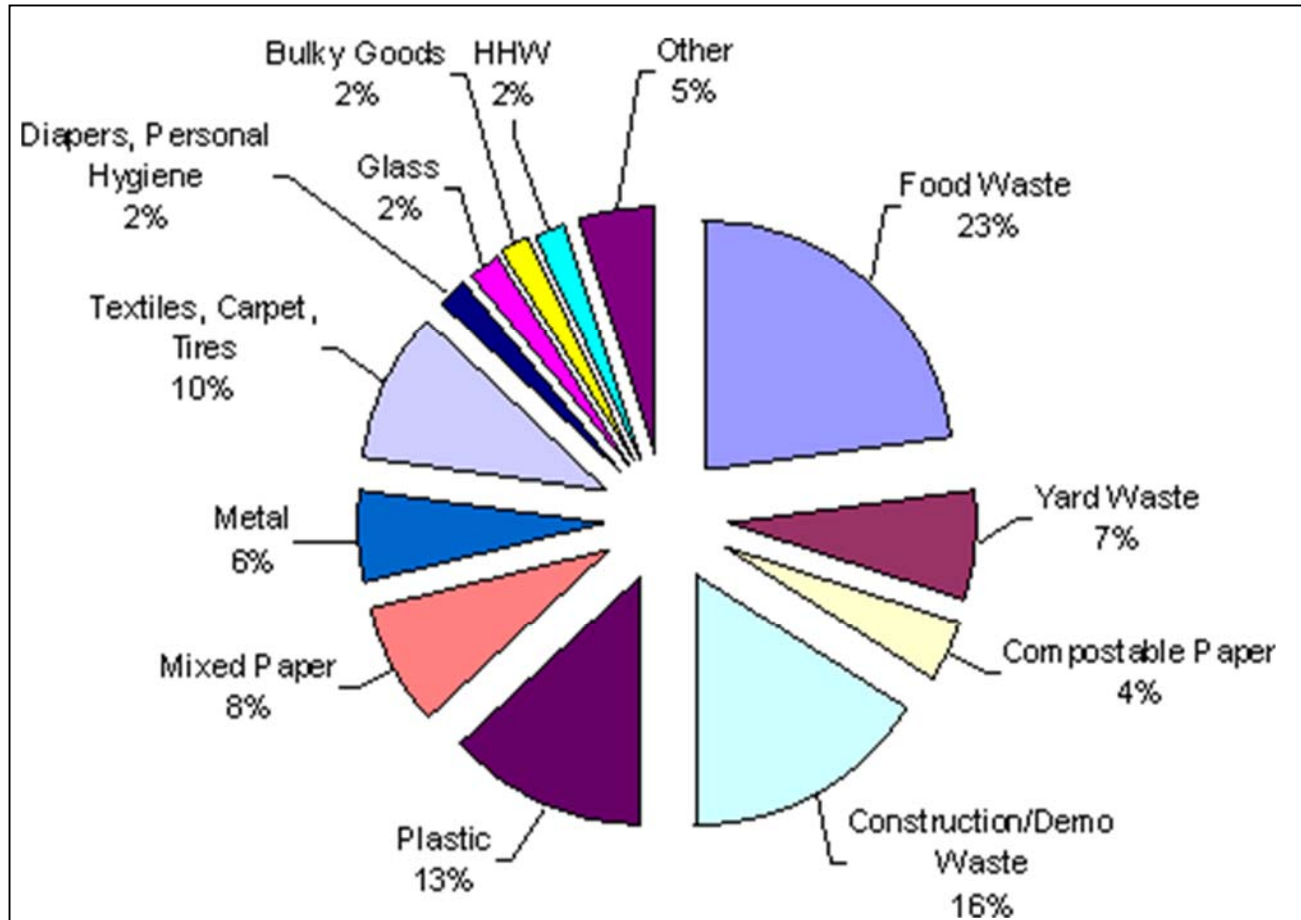e) What is the smallest expenditure of the federal government? _____

   Write this amount as a percent. _____

Answers to Graph One

a) Payments to Persons
b) 20¢   c) 7¢
d) 20¢; 20%   e)   Budgetary Surplus 4%

Graph Two

2004 Nanaimo Regional Landfill
Solid Waste Composition

Bulky Goods 2%
HHW 2%
Other 5%
Diapers, Personal Hygiene 2%
Glass 2%
Food Waste 23%
Textiles, Carpet, Tires 10%
Yard Waste 7%
Metal 6%
Compostable Paper 4%
Mixed Paper 8%
Construction/Demo Waste 16%
Plastic 13%

Source: http://www.rdn.bc.ca/cms.asp?wpID=1602

a) What makes up the largest part of the waste in the landfill site?

_____

b) What four categories contribute equal weight to the landfill site?

_____   _____

_____   _____

c) In a municipality of 139 000 people, the amount of waste going to a landfill site in one day is 150 tonnes.

    i)   What is the mass of plastics? _____

    ii) What is the mass of yard waste? _____

    iii) What is the mass of construction/Demo waste? _____

    iv) If all the food waste was composted, how many tonnes of waste would *not* end up in the landfill each day? _____

d) The plastics category can be separated into these categories:

- 6% Non-recyclable mixed plastics
- 4% film plastic
- 3% recyclable rigid food containers

If all the 3% recyclable rigid food containers were actually recycled, how many tonnes of waste would *not* end up in the landfill? _____

Answers to Graph Two

a) Food waste

b)
- Diapers, Personal Hygiene
- Glass
- Bulky Goods
- HHW (Household Hazardous Waste

c) i. 19.5 tonnes   ii. 10.5 tonnes   iii. 24 tonnes   iv. 34.5 tonnes

d) 4.5 tonnes

Topic E: Histograms

A histogram is a special bar graph that shows how a frequency (the number of times something happens) relates to a class interval (a range of numbers). **A histogram is useful when looking at how many times something happens**. It is useful to look at monthly or yearly temperatures, at test scores and groups of people based on age.

In the following graph, the height of each bar relates to how many days a temperature was between the listed temperatures in the horizontal axis.

This graph is created by counting how many days the temperatures were:

- between 0°C and -5°C (1 day)

- between -6°C and -10°C (6 days)

- between -11°C and - 15°C (8 days)

- between -16°C and - 20°C (5 days)

- between -21°C and -25°C (9 days)

- between -26°C and -30°C (2 days)

Then the information is put into graph form.

Graph One

**Daily Minimum Temperatures
in the Month of January, 2010**

Atlin, BC

Source: Environment Canada
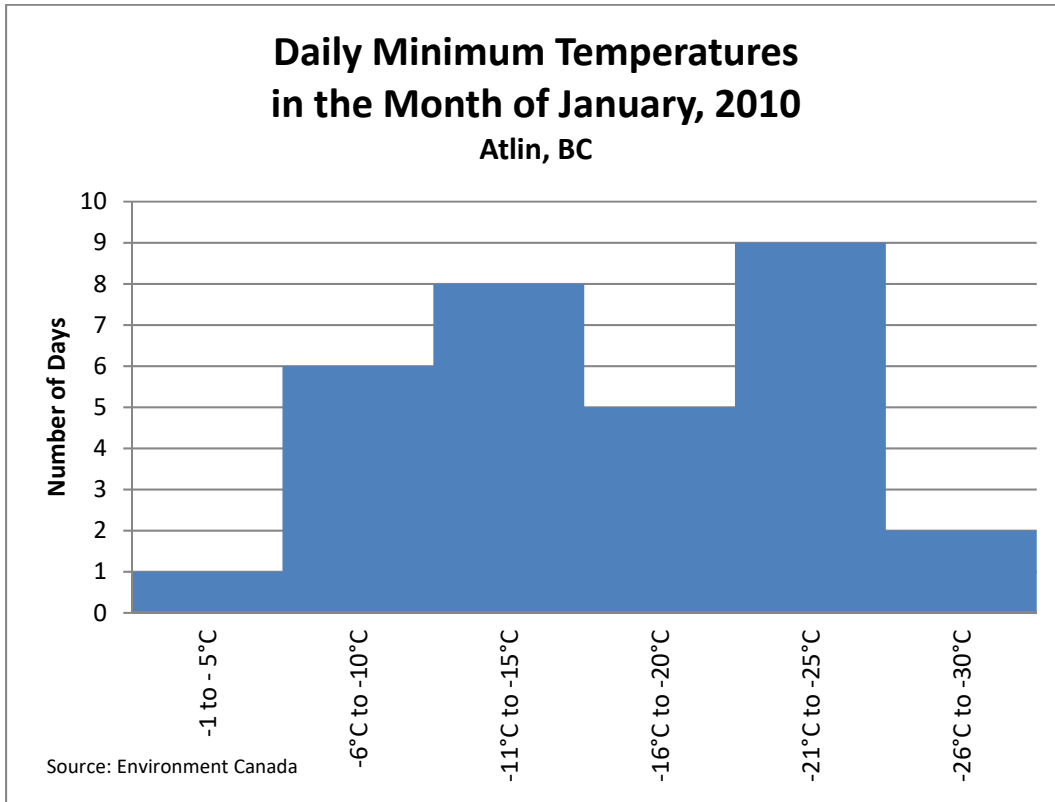
a) How many degrees in temperature change is in each bar? _____

b) What is the source of the information? _____

c) Which temperature was the most common in the month of January?_____

d) Which community does this graph represent? _____

e) Which temperature was felt the *least* in Atlin in January, 2010?_____

Answers to Graph One

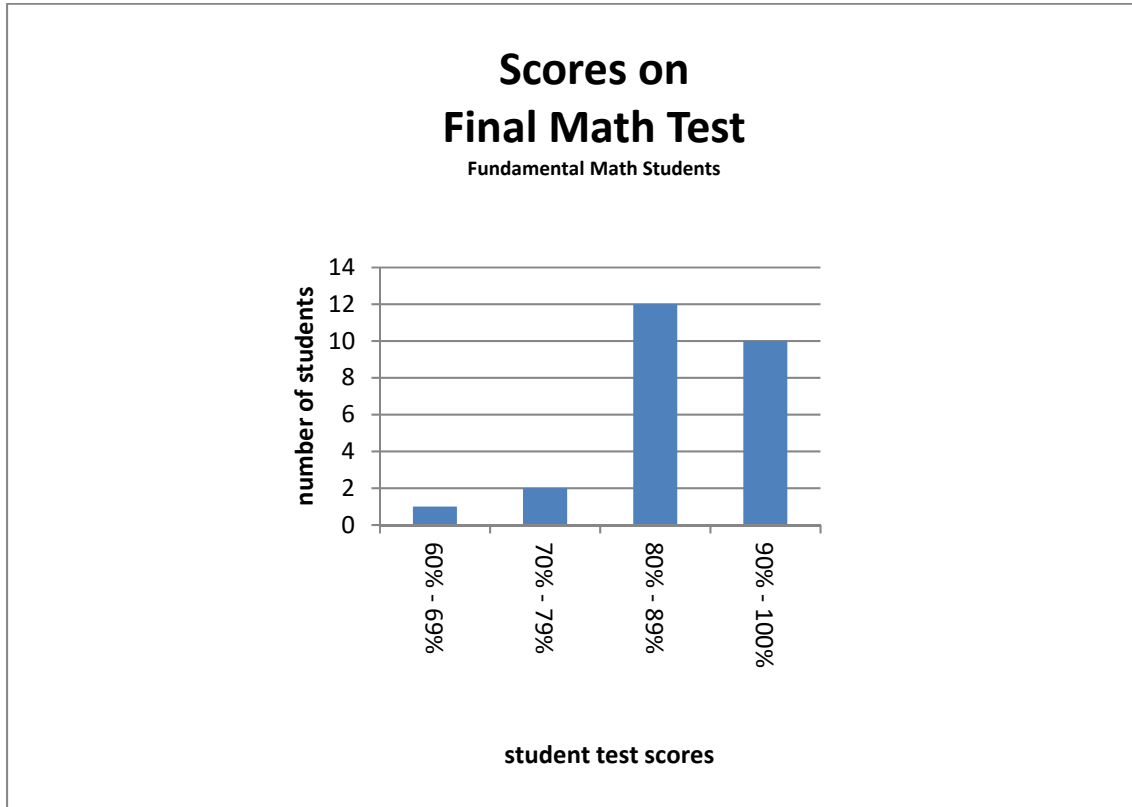a) five degrees   b) Environment Canada   c) -21°C to - 25°C

d) Atlin, BC   e) -1°C to -5°C

Graph Two

In this Fundamental Math course, students' marks were collected from the final test. The graph shows the results.

Scores on Final Math Test

Fundamental Math Students

a) How many students took the test? _____

b) How many students scored 80% to 89% on the test? _____

c) In order to pass, students must get 80% or over on the test. How many students will have to re-write the test? _____

d) How many more students got 80% to 89% than 90% to 100%? _____

Answers to Graph Two

a) 25   b) 12   c) 3   d) 2

Topic F: Tables

Tables are an everyday way of **organizing information, or one's own work**.

Graph One

The following table is from the BC Ferries website:

http://www.bcferries.com/schedules/mainland/copr-current.html.

It shows the departure times from each community.

Comox - Powell River (Little River-Westview)

Crossing Time: 1 hour 20 minutes
Distance: 17 nautical miles

Leave Comox (Little River)	Leave Powell River (Westview)
6:30 am *Daily except Dec 25 and Jan 1*	8:10 am *Daily except Dec 25 and Jan 1*
10:10 am	12:00 pm
3:15 am	5:15 pm
7:15 am	8:45 pm

a) How many ferry runs go from Powell River to Comox each day? _____

b) On what days does the ferry not run at 6:30 am and 8:10 am? _____

_____

c) How long is a crossing time? _____

d) When will the first ferry from Comox arrive in Powell River? _____

e) When will the last ferry from Powell River arrive in Comox? _____

f) How many nautical miles is covered by the ferry's course? _____

Graph Two

A cereal recipe explains the quantities to use when making hot cereal.

Servings	Salt	Water	Cereal
1	¼ tsp	1.5 cups	¼ cups
4	1 tsp	6 cups	1 cup

a) How much salt should be put in for one serving? _____

b) How much water is to be used when making 4 servings of cereal? _____

c) How many cups of cereal should be used for making 1 serving of cereal? _____

d) To make two servings of cereal, how much water is needed? _____

e) To make eight servings of cereal, how much cereal should be used? _____

f) To make ten servings of cereal, how much salt should be used? _____

Review

Refer back to each lesson on graphs and explain when to use each type of graph.

Line Graph: _____

_____

Bar Graph: _____

_____

Picture Graph: _____

_____

Circle Graph: _____

_____

Histogram: _____

_____

Table: _____

_____

TEST TIME!

Ask your instructor for the
Practice Test for this unit.

Once you've done the practice test,
you need to do the unit 5 test.

Now that you have completed the whole book,
you will need to do the final test.

Please see your instructor
for the practice test and the final test.

Good Luck!