Title: Gathering and Analyzing Data

Brief Overview:

In this unit students will learn how to generate, represent, interpret, and analyze data. Students will focus on graphically representing data and analyzing line graphs, pie graphs, and box plots.

NCTM 2000 Principles for School Mathematics:

- **Equity:** *Excellence in mathematics education requires equity - high expectations and strong support for all students.*

- **Curriculum:** *A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.*

- **Teaching:** *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*

- **Learning:** *Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*

- **Assessment:** *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*

- **Technology:** *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

Links to NCTM 2000 Standards:

- **Content Standards**

  <u>Problem Solving</u>
  Students will select, create, and use graphical representations of data including box plots, line graphs, and pie charts in order to discuss and understand the correspondence between data sets and their graphical representations.

  <u>Data Analysis</u>
  Students will learn about making a correspondence between data sets and their graphical representations.

  <u>Connections</u>
  Students will gather and interpret data relating to lung capacity.

  <u>Representation</u>
  Students will use three types of graphical representations including box plots, line graphs, and pie charts.

Links to National Science Education Standards:

- **Science as Inquiry**
- **Life Science**
- **Science in Personal and Social Perspectives**

Grade/Level:

Grade 7, Grade 8

Duration/Length:

3 days/ 50 minute period
2 days/ 90 minute mod

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Measures of central tendency.
- Construction of line graphs, pie graphs, box and whisker plots.

Student Outcomes:

Students will:

- Generate data by performing experiments.
- Represent data using line graphs, pie graphs, and box and whisker plots.
- Understand and interpret data.
- Analyze data.

Materials/Resources/Printed Materials:

- Package of circular balloons
- Tape measure
- Graph paper
- Calculator
- Ruler
- Protractor

Development/Procedures:

<u>Day 1</u>

- Drill: Identify the types of graphs pictured. (see Drill sheet)
- Engagement: (Class discussion) Ask students when each type of graph should be used to show: (1) change over time, (2) comparison of data, or (3) distribution of data.
- Experiment: Students will work in pairs to conduct an experiment that measures individual lung capacity. Each student will blow up a balloon with only one breath

and then measure the circumference of their balloon in centimeters using a tape measure (see experiment 1). Collect Class data on chalkboard. Groups will construct a pie chart and a box and whiskers plot from the collected class data. (see Worksheet 1).

- Discussion: Students will discuss the graphs constructed and the components involved with creating them.
- Closure: Based on the information gathered in today's experiment, students will be given real world scenarios that will allow them to choose which graph would best represent the information presented. (see Exit ticket Day 1).
- Homework: The homework will include two sets of data for which three different types of graphs should be constructed. This assignment will require students to represent one set of data in two different ways and another set of data, that will be best represented as a line graph, will be introduced in this homework assignment to serve as a lead into tomorrow's objective. (see Homework Day 1).

Day 2

- Drill: Building upon the previous day's homework assignment, students will justify their choice of graph for each homework problem.
- Engagement: (class discussion) Ask students which graph should be used to show comparison? Change over time? Distribution of data? Advise the students to use their homework to help answer these questions.
- Experiment: Students will conduct an experiment showing change over time using lung capacity. As a class every student will blow into a balloon with one breath and measure the balloon's circumference. (Balloons should be deflated after each measurement). Next, the class will perform five jumping jacks then immediately blow into the balloon with one breath and measure the circumference. This will be repeated in increments of five until they have completed twenty-five jumping jacks in one increment (Experiment Day 2).
- Discussion: Using the collected class data, students will decide which type of graph would best be used for this data and justify their decisions. Note that the responses should include the decision to create a line graph to show change over time.
- Closure: The class will complete the Exit ticket on things to think about. Note that one experiment is change over time and one is distribution. (see Exit Ticket)
- Homework: Students will be given three different scenarios and asked to determine which type of graph would best be used (see Homework Day 2).

Performance Assessment/ Enrichment Exercise:

Students will construct three types of graphs for given data.
Students will justify why they chose each graph to represent each situation.
Students will use information from the graphs to support their answer.
Students will analyze and interpret the data.
A rubric has been provided to use with the assessment.
See Performance Assessment Worksheet pages 1-4

Authors:

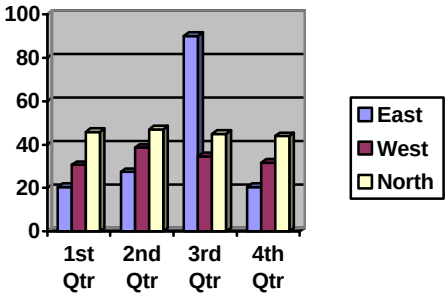
Thairen Dade
Southwest Academy
Baltimore County

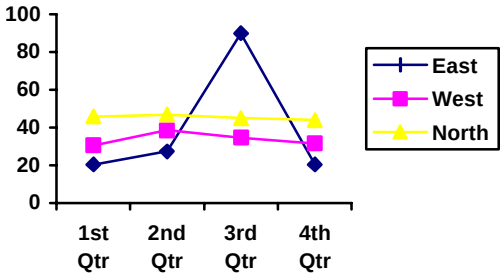
Debra Leathers
Franklin Middle School
Baltimore County

Kelly Weber
Pikesville Middle School
Baltimore County

NOTE: Worksheets/resources may be included on following pages.

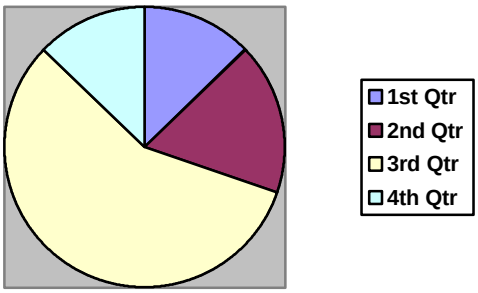
Identifying Graphs Drill

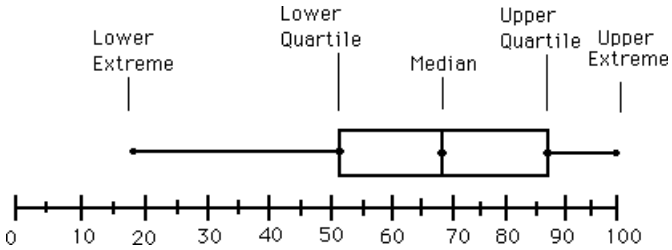




1. _____

2. _____





3. _____

4. _____

Balloons and Lung Capacity Experiment
Part 1

Materials:

One circular balloon for each student
Tape measure
Protractor

Directions:

1. Take one BIG breath.
2. Exhale the air into the balloon.
   Make sure to only exhale once into the balloon.
3. Pinch the end of the balloon.
4. Have your partner measure the circumference of the balloon.
   Record this measurement in centimeters below.

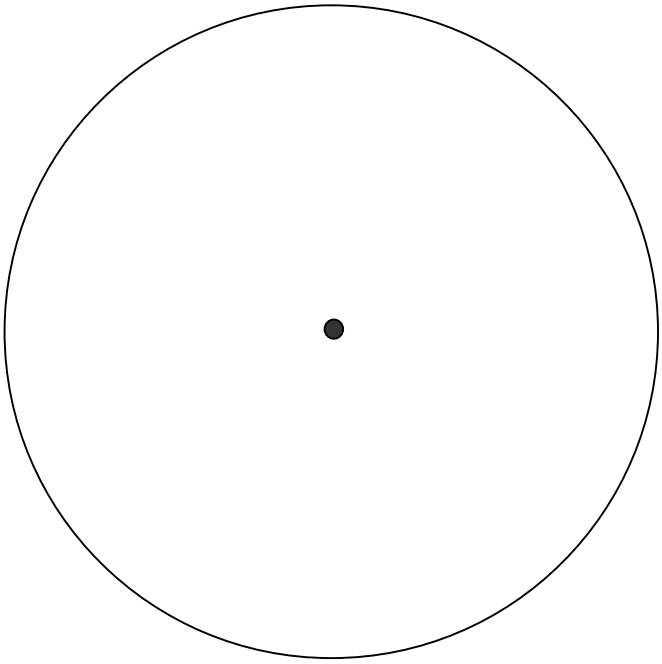
   _____
5. Switch partners, repeat steps 1-4 with your partner using their own balloon.
   Record this measurement in centimeters below.

   _____

Record the class Data in the chart provided below

Experiment 1 (one sheet per student)

Pie Chart of Class Data



Circumference	Fraction out of total students	Percent	Degrees
Less than 40 cm			
40-45cm			
46-51 cm			
52-57 cm			
58-63 cm			

Box and Whisker Plot of Class Data

(Label in increments of 5)

A cross-country runner needs to have a large lung capacity to run long distances. Think about the graphs we have constructed today, which graph would you use to determine the classmate that would be the best candidate for the cross-country team. Justify your answer using details and data collected from the experiment.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Exit Ticket Day 1 (one per student)

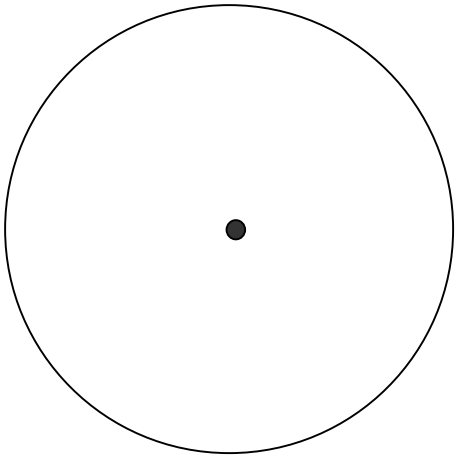
Which graph should we use?

Height Drops of Some Notable Roller Coasters

Drop in feet: 415 377 318 310 259 328
328 307 300 255 255

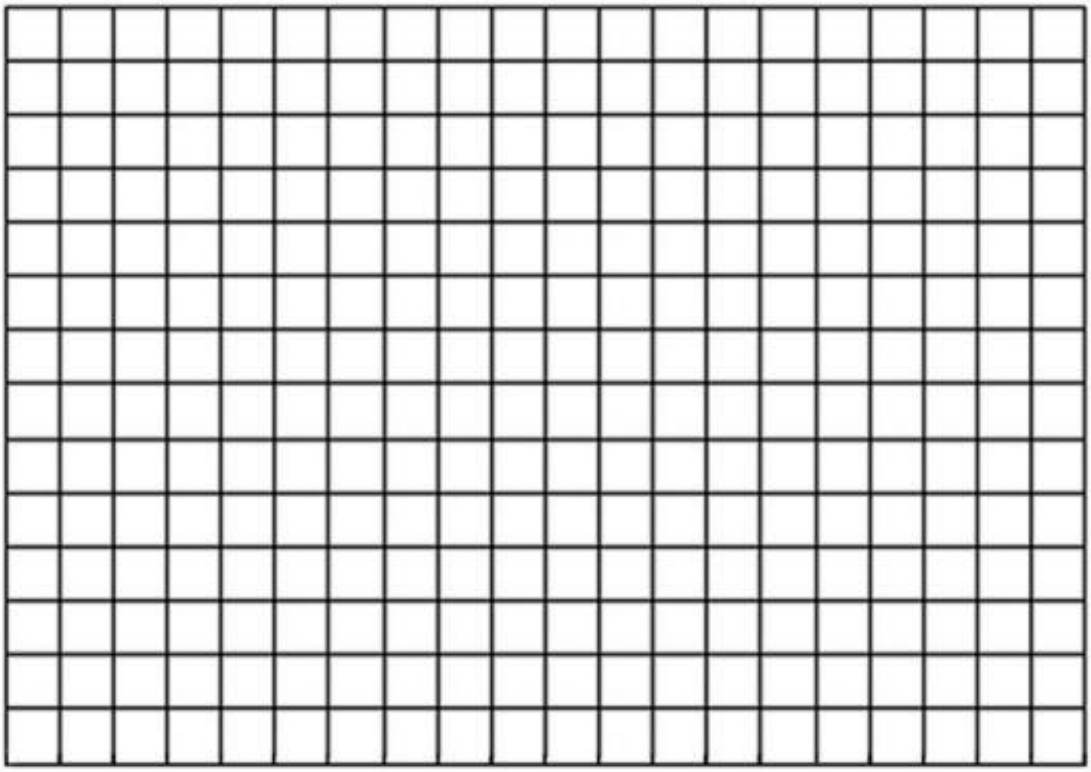
Using the Box and Whisker Plot, construct a pie graph showing:

- coasters between 255 and 280 feet
- coasters between 281 and 310 feet
- coasters between 311 and 330 feet
- coasters between 331 and 380 feet
- Coasters greater than 380 feet



Construct a line graph using the information below.

Name of Coaster	Height (ft)	Rides Time (sec)
Batman	105	90
Batwing	115	140
Boulder Dash	115	150
Canyon Blaster	94	105
Colossus	125	185
Desperado	209	163
Flashback	86	120



Balloons and Lung Capacity Experiment
Part 2

Materials:

One circular balloon for each student
Tape measure

Directions:

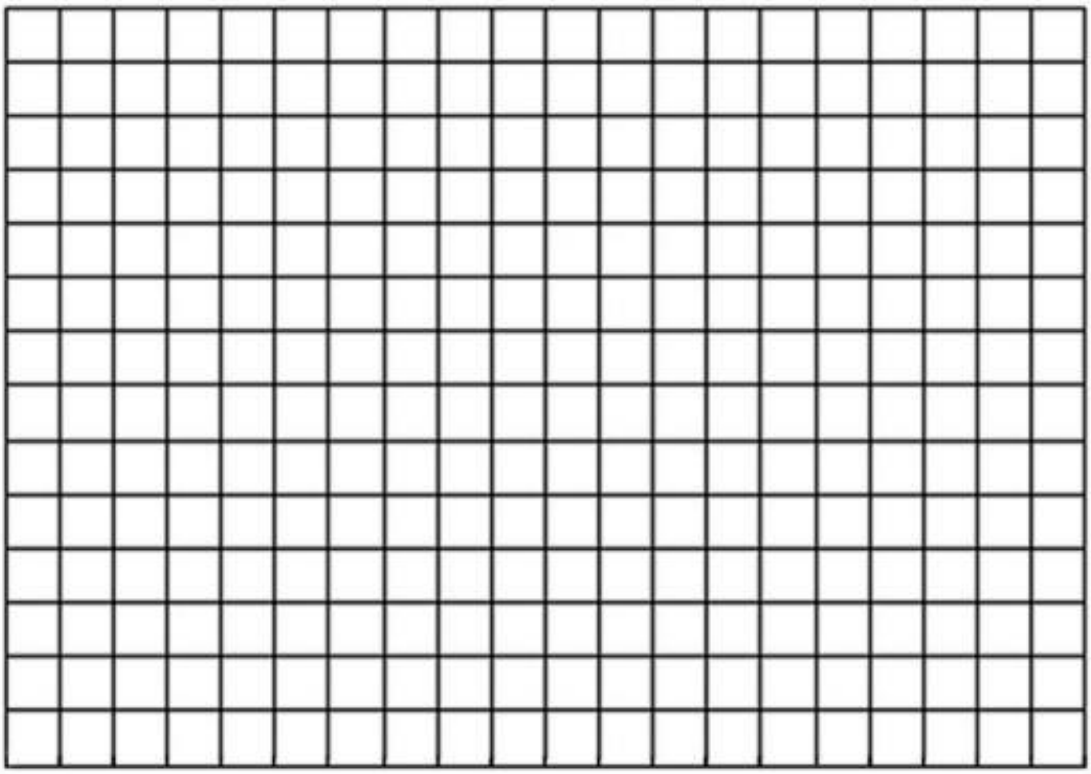
1. Take <u>one</u> BIG breath.
2. Exhale the air into the balloon.
   Make sure to only exhale only once into the balloon.
3. Pinch the end of the balloon.
4. Have your partner measure the circumference of the balloon.
   Record this measurement in chart.
5. As a class, do five jumping jacks.(you may alternate partner A jumping while partner B measures and vice-versa)
6. QUICKLY exhale one breath into the balloon.
7. Pinch the end of the balloon.
8. Have your partner measure the circumference of the balloon in centimeters.
   Record this measurement in the chart.
9. Repeat steps 5-9 in increments of 5 until you have completed twenty-five jumping jacks in one increment. * Important: Do not rest between each set of jumping jacks.

Lung Capacity over Time

Number of Jumping Jacks	Circumference (cm)
0	
5	
10	
15	
20	
25	

Line Graph

Use the collected data to construct a line graph.



Things to Think About!

1. What is the difference between today's experiment and yesterday's experiment?

   _____
   _____
   _____
   _____
   _____
   _____

2. Why could you use a line graph for today's information, but not use it for yesterday's information?

   _____
   _____
   _____
   _____
   _____
   _____

Which Graph Should We Use?
Part 2

1. John's brother is going off to college. His annual tuition is $15,000 a year. Which type of graph would you use to determine the cost of tuition four years from now? Would this graph be able to predict what the cost may be in 10 years?

   _____

   _____

   _____

2. Maria plays volleyball and softball. She wants to join a sport that has the greatest turn out of fans. Which type of graph should she use to determine which sport to join?

   _____

   _____

   _____

3. You just received your score from a recent test. Which type of graph would you use to see where your score of 85% lies in comparison to the rest of the class?

   _____

   _____

   _____

Homework Day 2 (one sheet per student)

Smoking and Cancer

Question 1

Study the given data. Think about how this information can be represented as a line graph, pie chart and a box plot. List what information is shown on a:

Line Graph: _____

Pie Chart: _____

Box Plot: _____

Below is a listing of the average age of smokers diagnosed with cancer from 1973 to 1998. (Source: American Cancer Society)

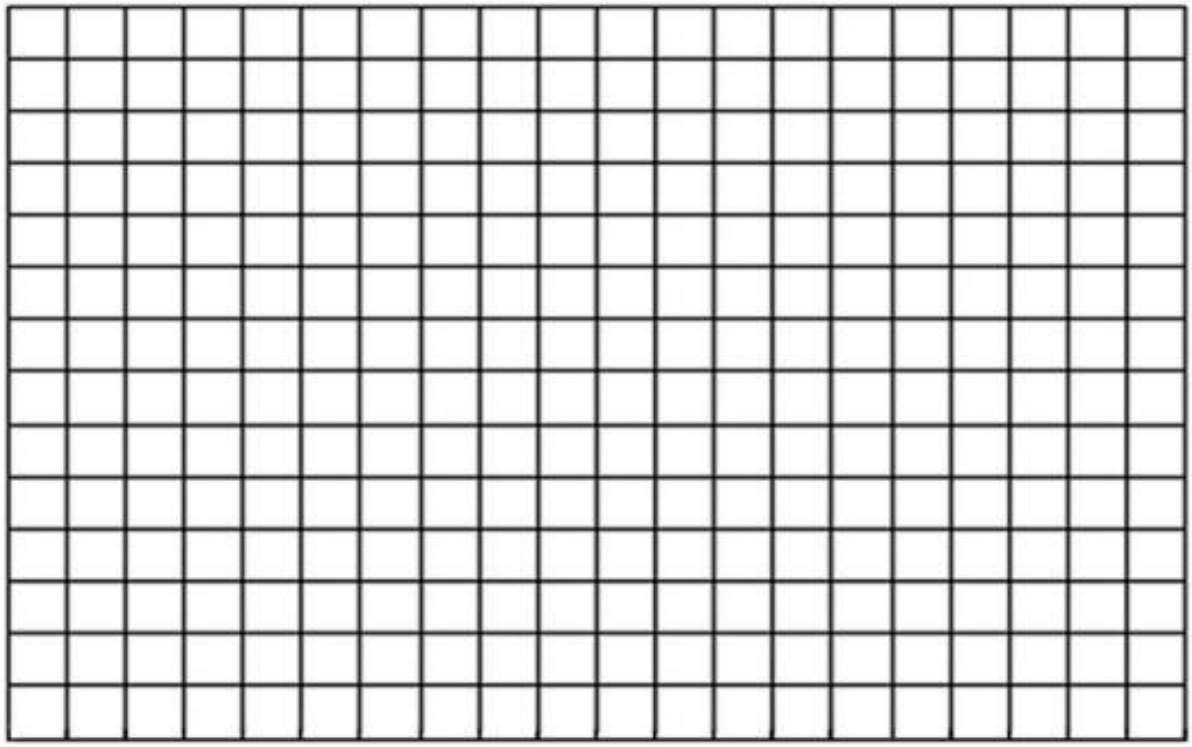
Year	Average Age	Cancer per 1000 smokers
1973	42	320
1974	44	333
1975	45	334
1976	48	338
1977	49	338
1978	50	338
1979	51	341
1980	52	346
1981	54	352
1982	55	352
1983	55	357
1984	57	365
1985	56	372
1986	57	374
1987	59	388
1988	59	385
1989	58	388
1990	59	400
1991	60	418
1992	60	426
1993	58	413
1994	57	403
1995	57	399
1996	56	400
1997	56	404
1998	55	395

Question 2

- Construct a line graph showing the average age of smokers diagnosed with cancer over the years.
- Construct a pie chart showing the percentage of smokers within a designated age group.

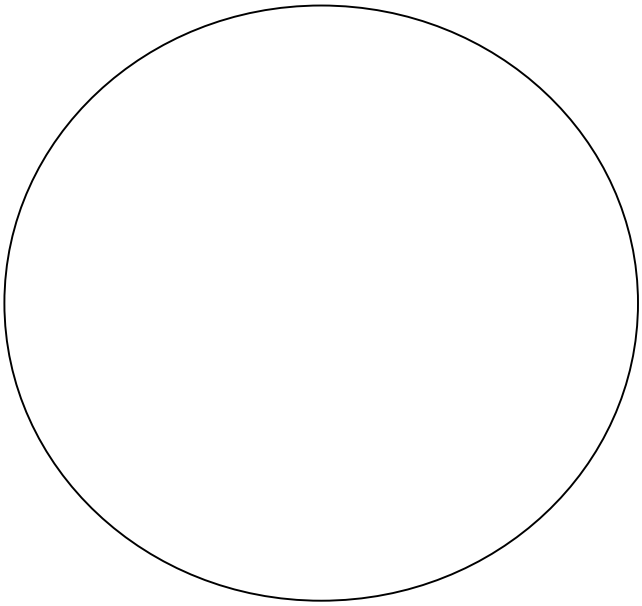
Line graph

_____



Pie Chart

_____



Age in years	Fraction out of 26	Percent	Degrees
42-44			
45-47			
48-50			
51-53			
54-56			
57-59			

Question 3

Can the information given be represented using all three types of graphs? Why or why not? Justify your response with supporting details.

_____
_____
_____
_____
_____

Question 4

Suppose you were making a presentation to a major tobacco company regarding the effects of smoking and its relationship to lung cancer. Using specific data representation from your graphs, create a presentation that will convince them to fund cancer research.

Think about the age range with the highest diagnoses of cancer. Think about the predicted levels of lung cancer for the upcoming years.

Now write a proposal convincing the Tobacco Company to fund cancer research.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Smoking and Cancer
Scoring Rubric

3

- Question 1 lists all purposes for each type of graph.
- Question 2 line graphs is constructed and labeled correctly (ex. title, axis, intervals, labels, and scale).
- Question 2 pie charts is constructed and labeled correctly (ex. Title, axis, intervals, labels, scale).
- Question 3 shows evidence from prior experience to justify the response.
- Question 4 uses specific data from all three graphs.
- Question 4 includes the age range for the highest diagnosis for cancer.
- Question 4 predicts from the graphs the levels of cancer in the up coming years.
- Question 4 has all components in 3 to 5 sentence paragraphs with all components justified.

2

- Question 1 is missing one purpose for each type of graph.
- Question 2 line graphs is constructed and labeled with one important part missing (ex. title, axis, intervals, labels, and scale).
- Question 2 pie charts is constructed and labeled with one important part missing (ex. Title, axis, intervals, labels, scale).
- Question 3 shows some evidence from prior experience to justify the response.
- Question 4 uses some specific data from all three graphs.
- Question 4 includes the age range for the highest diagnosis for cancer.
- Question 4 some prediction is made from the graphs the levels of cancer in the up coming years.
- Question 4 has some components in 3 to 5 sentence paragraphs with some components justified.

1

- Question 1 is missing two purposes for each type of graph.
- Question 2 line graphs is constructed and labeled with more than one important part missing (ex. title, axis, intervals, labels, and scale).
- Question 2 pie charts is constructed and labeled with more than one important part missing (ex. Title, axis, intervals, labels, scale).

- Question 3 shows little evidence from prior experience to justify the response.
- Question 4 uses little specific data from all three graphs.
- Question 4 does not include the age range for the highest diagnosis for cancer.
- Question 4 little prediction is made from the graphs the levels of cancer in the up coming years.
- Question 4 has few components in 3 to 5 sentence paragraphs with few components justified.

0

- Question 1 is missing all purposes for each type of graph.
- Question 2 line graphs is not constructed and labeled (ex. title, axis, intervals, labels, scale).
- Question 2 pie charts is not constructed and labeled (ex. Title, axis, intervals, labels, scale).
- Question 3 shows no evidence from prior experience to justify the response.
- Question 4 uses no specific data from all three graphs.
- Question 4 does not include the age range for the highest diagnosis for cancer.
- Question 4 has no prediction made from the graphs levels of cancer in the up coming years.
- Question 4 has no components in 3 to 5 sentence paragraphs with no components justified.