

Title:	Poppin' Graphs that Excel
Grade(s):	4
Subject(s):	Math
Author:	ICAC Team
Overview:	The class will collect data related to popcorn and use the data to construct bar, circle, and line graphs. The students will then use Microsoft Excel to graph the same data sets.
Content Standards:	<p>MA(4) 15. Represent categorical data using tables and graphs, including bar graphs, line graphs, and line plots.</p> <p>MA(4) 17. Represent numerical data using tables and graphs, including bar graphs and line graphs.</p> <p>TC(3-5) 9. Use technology tools to organize, interpret, and display data.</p>
Local/National Standards:	
Primary Learning Objectives:	Using a desktop or laptop computer and Microsoft Excel , students will create a bar graph, circle graph, and a line graph representing data collected concerning class members' preferred popcorn flavor and volume of popcorn.
Additional Learning Objectives:	
Approximate Duration of Lesson:	90 Minutes – Can be divided into two 45 minute sessions
Materials and Equipment:	Pre-popped popcorn, bags for each group and baggies or small cups for each student, markers, chart paper or a dry erase board to record class data, data sheets and blank graph templates (see attached), measuring cup marked in oz. for each group, several different sized cups or similar containers (e.g. 8oz, 12oz, 16oz, etc.) - one per group.
Technology Resources Needed:	Desktop or laptop computer, Excel or other spreadsheet. The directions in this activity are based on Excel 2010. You may need to adjust your directions and illustrations if you are using a different version of Excel or different spreadsheet software.
Background/Preparation:	<ul style="list-style-type: none"> • Popcorn should be popped and divided into different bags, one bag for each group plus individual baggies of popcorn for each student. • The class should have a basic understanding of graphs and charts. • The class should be familiar with the basics of using the Microsoft Excel software.

**Procedures/
Activities:**

Step 1 Ask students “How many of you like popcorn?” List these popcorn flavors on the board or overhead: Plain, butter, caramel, chocolate, cinnamon, barbecue. Ask “Which flavor of popcorn is best?” Ask students how they could determine the most popular flavors. (*Students should suggest that they survey people to see which kind they like.*)

Tell students that they need to decide which flavor of popcorn is the favorite in their group. They will poll their group members, record the choices, and graph the data on the graph paper that is handed out.

Ask students to name several types of graphs. (*They may suggest line graphs, bar graphs, and pie charts.*) Ask them which type of graph they should use to display the results of their popcorn flavor survey? Before students conduct their surveys, tell students that you will review 3 important types of graphs and how to make them. Be sure that they understand information about how graphs provide a visual display representing a relationship or trend. Have examples of bar graphs, circle graphs (pie charts), and line graphs on the board or overhead. Review as much of the following information as your students need.

Graphs show the relationship between two sets of observations or measurements called **independent (manipulated)** and **dependent (responding)** variables. The independent variable is the one that you manipulate or control and the dependent variable is the one that responds to the manipulation and is measured. For example, if you wanted to see the effects of different amounts of fertilizer on the growth of tomato plants, you might set up an experiment with four groups of plants. You could add one teaspoon of fertilizer to one group of plants, 2 tsp. to a second group, 3 tsp. to a third group. The fourth group of plants would not get any fertilizer; it would serve as your control. You would then measure the growth of the plants over a period of time.

Ask students “In this example what is the independent or manipulated variable? (*The amount of fertilizer that you add.*)

What is the dependent or responding variable? (*The growth of the tomato plants - how high they grow, or how many tomatoes they produce, etc.*)

When graphing data, the rule is to place the independent variable on the **X** (horizontal) axis, and the dependent variable on the **Y** (vertical) axis of the graph.

In a **vertical bar** (or **column**) **graph**, the independent variable is a series of **categories**, e.g., colors such as red, green, blue, or teams, such as Tigers, Crimson Tide, or Blazers. The dependent variable shows the amounts in each category. On a bar graph you can easily see how the amounts of each category compare with all other categories by comparing the heights of the bars.

A **circle graph** (pie chart) has categories just like a bar graph, but the number in each category is represented by the size of its slice of the pie instead of the height of a bar. Pie charts are used when the data represent 100% of the categories. Each slice of the pie represents the percentage for that category of the whole data set (pie).

A **line graph** (or **line plot**) is a graph where both the independent variable and the dependent variable are **numbers**. Both the X and Y axes will be evenly divided into scales of numbers (1, 2, 3, 4 or 5, 10, 15, 20, etc.) The line graph has a series of data points (dots on the graph) corresponding to the value of the dependent variable for each value of the independent variable. The dots may be connected with straight lines to show the fluctuations in the data, or a smooth line (line of best fit) may be drawn that averages the points and shows the overall trend of the data.

Step 2 Tell students that you are going to collect some data from them to use to construct different types of graphs. Set up a table on the board or on your computer with 4 categories for flavors of ice cream: *vanilla, chocolate, strawberry, and butter pecan*. Do a quick survey to determine the number of students who prefer each flavor and record the totals on the table. Then on the board or on the graph template on your computer,

have students tell you how to construct a **vertical bar graph** with each flavor listed as a category on the X axis and a scale for the number of students on the Y axis. (You could set up the graph in advance using the Word Graph Template at the end of this lesson plan. Replace the Category names with the names of the ice cream flavors and eliminate the categories and numbers that you do not need.)

Graph the data. Make sure that each axis is labeled and that the graph has a descriptive title (e.g., Favorite Flavors of Ice Cream).

When the bar graph is complete, create a **circle graph** (pie chart) using the same data. Use the circle graph template (attachment) or draw a circle on the board. Demonstrate to students how to convert each category count into a percentage of the whole. (Divide the number of students in each category by the total number of students and multiply by 100 to get a percent.) The number in each category is represented by the size of its slice of the pie. The size of the slice may be estimated by referring to the lines on the circle graph template, which are marked off in 5% increments. Most pie charts have a key to indicate the names of the categories (slices).

You can extend this activity by teaching students how to convert percentages into degrees (multiply 360 degrees by the decimal percentage for each section of the pie) and how to use a protractor to determine the correct size for each section.

Illustrate a **line plot** by showing the attached table on the accuracy of hitting a target bullseye with a piece of thrown popcorn. (If you have time, you could divide the students into groups, place a target on the floor, and collect real data to use for the graph.) Show the students the data table on your computer or copy it to the board. Plot the data in the table on the Graph Template. (You can set up the graph ahead of time by eliminating the category names and labeling each axis.)

Step 3 Once you have gone over the graph examples, divide the class into groups of 3 or 4. Tell students that they will now collect some real data to use to construct graphs. Their first task is to decide which flavor of popcorn is the favorite in their group.

Handout the Student Data sheet and 3 sheets of graph paper (attached) and the supplies needed for the Popcorn Volume activity (bag of popcorn, measuring cup, large cup or other container).

For Part A of the Activity, students will poll their group members, record their choices, and graph the data on the graph grid and on the circle graph paper that is handed out.

For Part B, students will estimate and measure volume and capacity of popcorn for a measuring cup and another container, then construct a line plot on the graph grid that is handed out.

Move around the room while groups are working to assess their graphs. Remind them to label each graph with titles for the graph and each axis and to construct a key for the pie chart.

When all groups have completed their graphs, have each group place their totals on the table on the board or overhead. When all class data has been collected, have students fill-in their data sheets for the class totals. (These data will be used later to construct graphs using Microsoft Excel.)

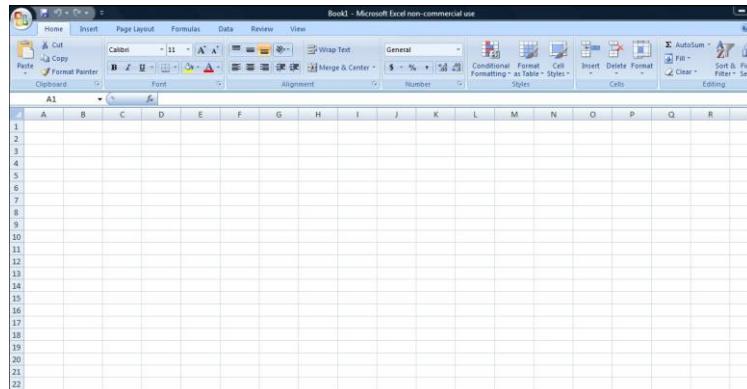
NOTE: The lesson can be temporarily stopped here to be continued in a later session.

Step 4 Tell students that we will now use Excel to create graphs of their class data. Each group of students will first create a bar graph and a circle graph using Microsoft Excel and the class data on favorite flavors of popcorn. Make sure good collaboration is taking place in each group. It might be beneficial to assign roles within each group if needed.

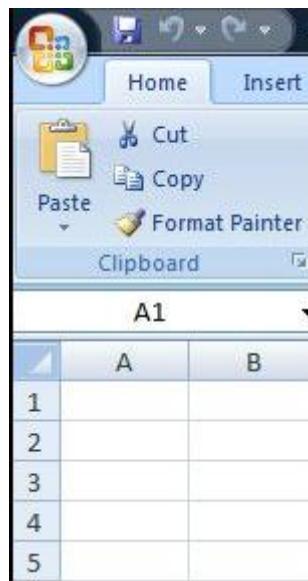
Demonstrate how to open Microsoft Excel by clicking this icon:



The screen should load and then look like this:



Tell students that they should now enter the class data from Table 2 into the “A” cells (which will become the horizontal X axis) and the “B” cells (vertical Y axis).

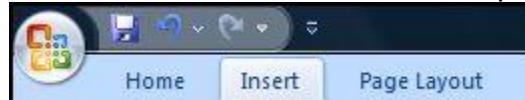


Enter the popcorn flavors in cells A1, A2, A3, A4. Then enter the number of students who like each flavor in cells B1, B2, B3, B4. (sample data below)

	A	B
1	Buttered	10
2	Salted	7
3	Plain	4
4	Caramel	15

Now, we will create the graph by highlighting the information in cells A and B (Begin by clicking the mouse at the top left corner of A1 and drag the mouse to highlight the data in each cell through B4).

Next, click the “Insert” tab at the top left of the screen.



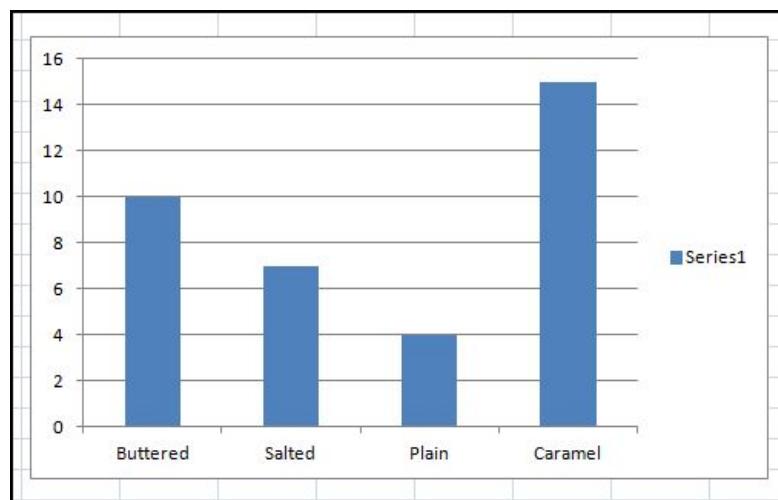
Ask students which type of graph should be used to display the data, bar (column) graph or a line graph? Why?

A vertical bar (column) graph should be used because the independent variable is categories (flavors of popcorn), not numbers.

To create a vertical bar (column) graph, click on “Column” tab and choose a graph that shows several vertical columns:



The graph will be generated on the spreadsheet. When finished the screen should look something like this:



Next we need to label the horizontal and vertical axes.
Click on the “Layout” tab.

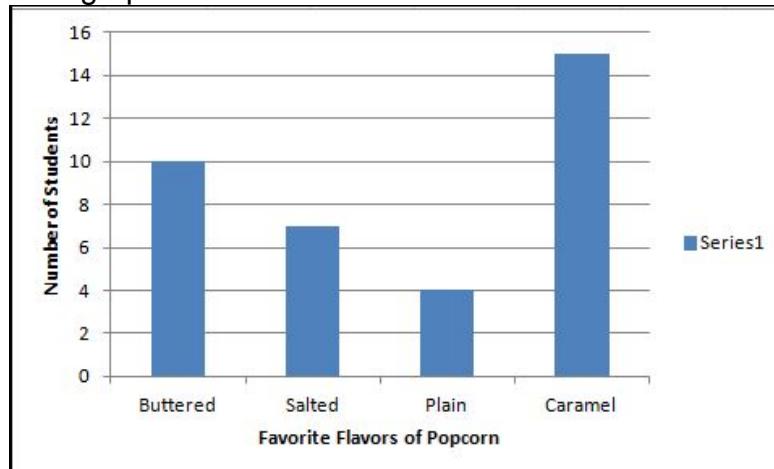


Now click on the “Axis Titles” tab:



Click on Primary Horizontal Axis Title and label the axis, **Favorite Flavors of Popcorn**.

Click on Primary Vertical Axis Title, then click on Rotated Title and label the axis **Number of Students**.
Your graph should look like this:



NOTE: It's always a good idea to save your work as you go along. This is a good point to stop and save. Go to the “Home” icon and click on the “Save” tab.

At this point the teacher should go around the room and check each group's work.

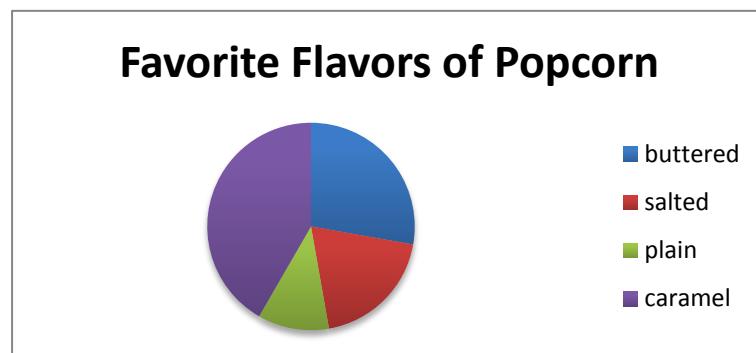
Step 5 Next, we will use the same data to create a **circle graph (pie chart)**.

Highlight the information in cells A and B (Begin by clicking the mouse at the top left corner of A1 and drag the mouse to highlight the data in each cell through

B4).

Next, click the “Insert” tab at the top left of the screen and choose “Pie” as the type of graph. The graph will be generated on the spreadsheet. Add a title. To move the graph on the screen, click and drag it with the mouse so that both graphs are visible.

When finished the screen should look something like this:



Check to see that all groups have completed their graphs correctly.

Step 6 Tell students that they will now use Excel to create a Line Plot.

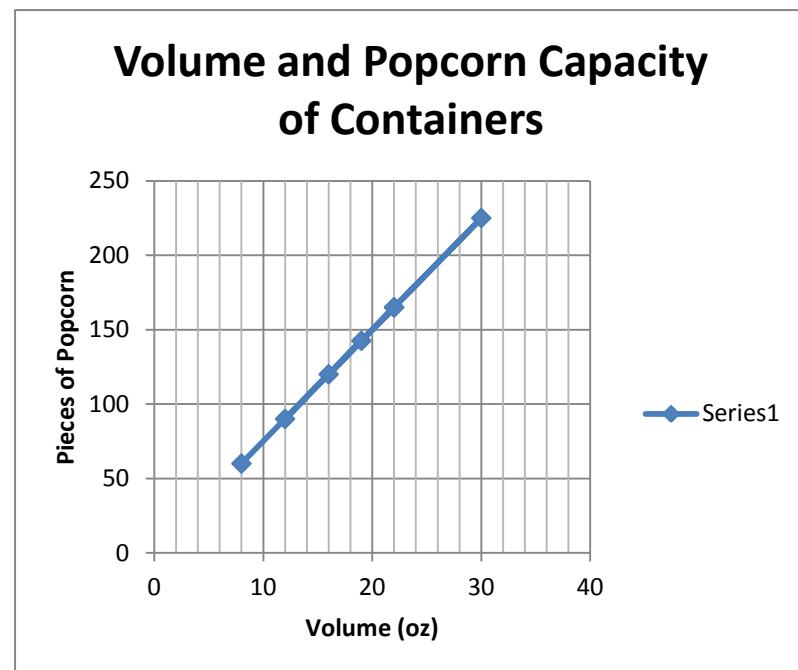
Create a line plot graph showing the Class Total data in Table 4 showing the volume and number of pieces of popcorn each container will hold.

Excel refers to Line Plots as Scatter Plots. (The Line Graph in Excel is not a true line graph; it treats the independent variable as categories rather than continuous numbers.) To create a line plot, choose **Scatter Plot**. Highlight the two columns of numbers, then click on “Insert.” Repeat the steps that you used to create the column graph, however instead of choosing the “Column” tab choose the “Scatter Plot” tab.



Chose a plot that has dots connected by lines.

The completed graph should look something like this:



Remind students to save their work.

Step 7 Closure: Have students summarize the characteristics of each graph type and when to use them.

Attachments:

Assessment Rubric
Popcorn Lab Student Data Sheet
Line Plot Example
Bar and Line Plot Graph Templates
Circle Graph Template

Assessment Strategies:

Attached.

Extension:

Have students collect other data and create other graphs and charts. Some ideas might be for them to record how students get home either by bus, pick-up, or walk or have them record whether students bring a lunch from home or get a hot lunch from school. To extend this activity into the home environment have them collect other types of data such as how often certain commercials are seen during a specific show or how much sleep they get each night for a week.

Remediation:

Have students label different types of graphs or provide them with the frame work for each graph and have them complete the graph based on the data.

Assessment for Poppin' Graphs

Score	1	2	3	4
Participation	No participation in the activity.	Some participation, but did not work well with the group.	Participated throughout activity, contributed to the successful outcome.	Worked well with everyone in group, offered ideas, contributed to successful outcome.
Charts/Graphs	Did not complete a bar graph, circle graph, and line plot.	Created a bar graph, circle graph, and line plot, but they contained more than two errors.	Created a bar graph, circle graph, and line plot that accurately represented the data, but with one, or two, numerical or graphical errors.	Created a bar graph, circle graph, and line plot that included all required elements of a graph and accurately represented the data.

Popcorn Lab Student Data Sheet

Part A: Favorite Flavors

1. Obtain 2 sheets of graph paper (one grid and one circle) for your group.
2. Answer the following questions about your favorite flavors of popcorn.
 - a. My favorite flavor of popcorn (from list below) is _____ because _____.
 - b. My least favorite flavor of popcorn is _____ because _____.
3. Determine the number of votes in your group for each flavor and record the group totals for each flavor in Table 1.

Table 1: Group Data

Flavor of Popcorn	Number in group picking this as favorite flavor	Number in group picking this as least favorite flavor
Plain		
Butter		
Caramel		
Chocolate		
Cinnamon		
Barbeque		

4. Use the results of your group survey to construct a **vertical bar graph** and a **circle graph** (pie chart) for the **Favorite Flavor** data in Table 1.
5. Record your group data for favorite flavor on the Class Data Table on the board.
6. Record the Class Data Totals in Table 2 below. (This table will be used for graphing in a later activity.)

Table 2: Class Data

Flavor of Popcorn	Number of classmates picking this flavor as their favorite							
	GROUP:	1	2	3	4	5	6	TOTAL
Plain								
Butter								
Caramel								
Chocolate								
Cinnamon								
Barbeque								

Popcorn Lab Student Data Sheet – page 2

Part B: Popcorn Volume

1. Get the materials for this lab: large bag of popcorn, measuring cup, large drink cup or other container, sheet of graph paper grid.
2. Estimate how many pieces of popcorn it will take to fill the measuring cup (8 oz) level to the top. _____
3. Count how many pieces of popcorn it takes to fill an 8 oz measuring cup completely full. Record in Table 3. How close was your count to your estimate?
4. Estimate how many pieces of popcorn it will take to fill the large drink cup or other container. _____
5. Describe how you could determine the volume in oz of the large drink cup using the materials that you have.
6. Describe how you could determine how many pieces of popcorn the large drink cup would hold without counting every piece.
7. Record your group data for volume and # pieces on the Class Data Table on the board.
8. Record the Class Data Totals from the board on Table 4 below. Use the Volume and # of pieces of popcorn data from this table to construct a **line plot graph** on your sheet of graph paper.

Table 3: Volume and Popcorn Capacity of Containers

Container	Volume (ounces)	# pieces of popcorn to fill container
Measuring Cup	8 oz	
Large container		

Table 4: Class Totals: Volume and Popcorn Capacity of Containers

Container	Volume (ounces)	# pieces of popcorn to fill container
Measuring Cup	8 oz	
Group 1 Container		
Group 2 Container		
Group 3 Container		
Group 4 Container		
Group 5 Container		
Group 6 Container		

Line Plot Example

A target with a two-inch diameter bullseye was placed on the floor. Four students in a group took turns throwing a piece of popcorn at the bullseye from different distances from the target. The distance from the bullseye that the popcorn landed was measured for each trial. The average for the four students for each trial was calculated and recorded in the table below.

Independent Variable: _____

Dependent Variable: _____

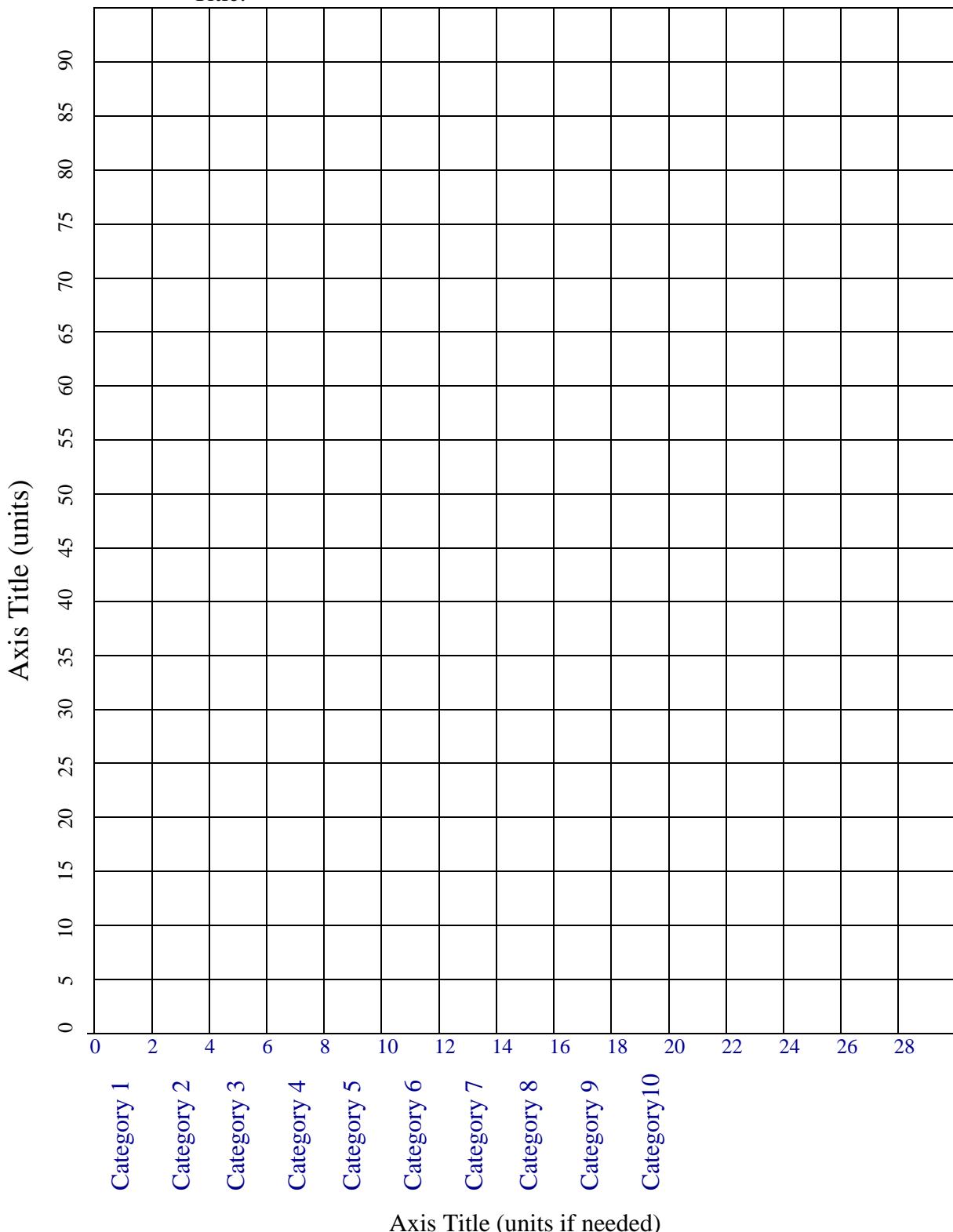
Graph Type: _____

Table: Accuracy of Popcorn Throw from Different Distances

Starting Distance from Target (in)	Avg. Distance from Bullseye (in)
12	0
24	2
36	5
48	8
60	12
72	18

(Template for Bar Graphs and Line Plots. Insert Graph Title and Axis Titles and units. On Y Axis: Adjust number scale if needed. On X Axis for Bar Graph: delete the numbers and replace Categories in blue with appropriate Category names. For Line Plot: delete Category names and change numbers to appropriate scale if needed.)

Title:



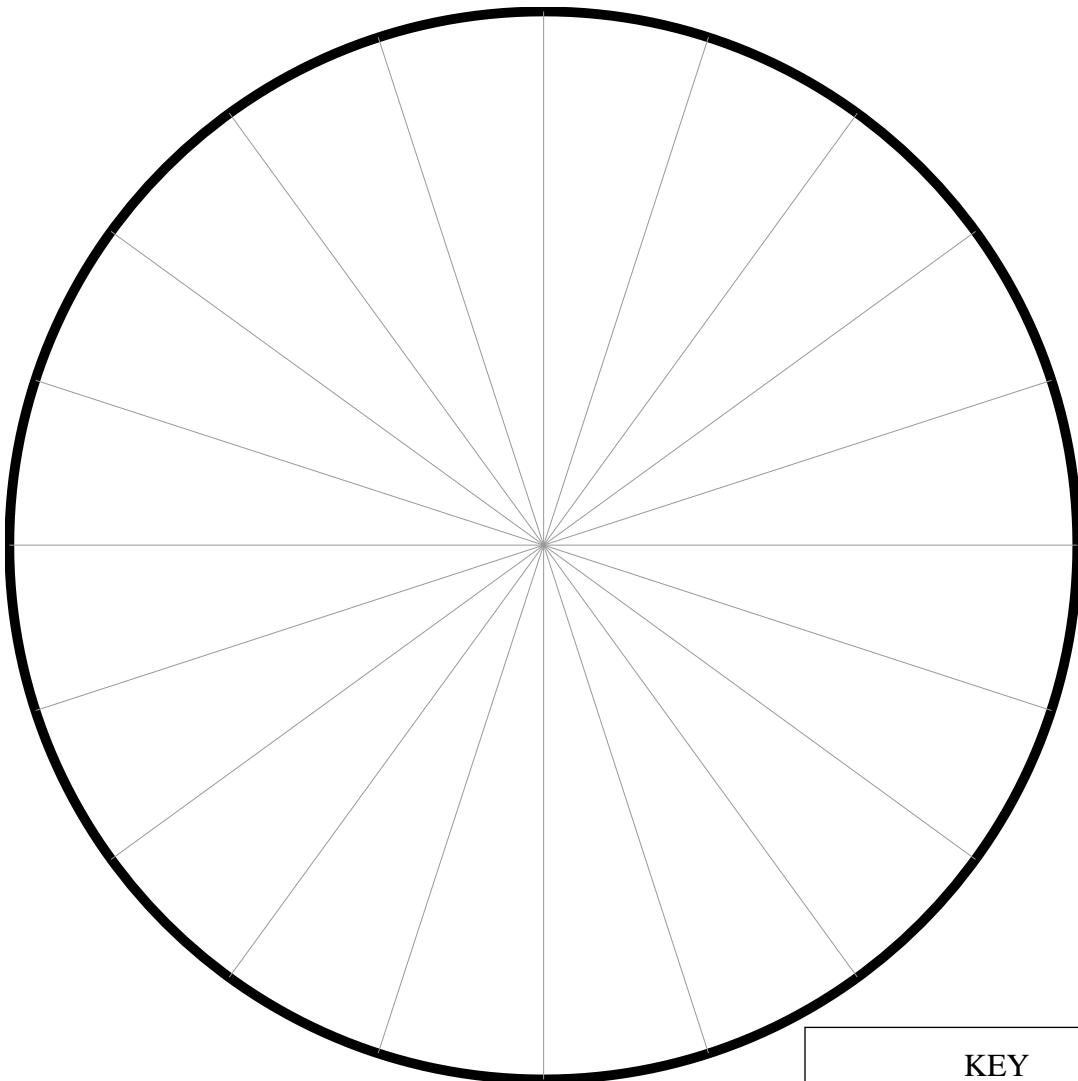
Name _____

A blank 10x10 grid of squares, suitable for various applications such as graphing or data representation.

Circle Graph

Name: _____
Date: _____

Title:



KEY

Each division = 5% of circle