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Are We Couch Potatoes or Busy Bees? Data Analysis of Physical Activity in School

Curriculum Unit 08.06.09
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Introduction

Many students have a difficult time reading and understanding graphical data. This unit is intended to help students reach mathematics curriculum goals for intermediate elementary grade level. The unit employs an interdisciplinary approach that connects graphical analysis with other curriculum areas including health, the scientific method, and educational technology. It should take at least one month so that students are afforded enough time to collect their own data, graph it, and properly analyze it. The end result product is useful for any student who wishes to use it in a science fair.

Objectives

Increasing student health and integrating technology into everyday classroom lessons are two separate initiatives many schools share. My goal in this unit is to combine these two initiatives so students can learn practical data analysis and representation all within the constraints of the Scientific Method. In my unit, *Are we couch potatoes or busy bees?: Data Analysis of Physical Activity in School* , students will take a proactive role in collecting data, entering the data into a computer spreadsheet program, creating pictorial representations of the data, and analyzing the data based on the various representations made by the class. The students will create appropriate graphs and/or charts to show the school-wide data over the course of the unit. Since the data will be collected on physical activity, the goal is to encourage the participating classes to compete with one another. This competition will determine which class completes the most amount of physical activity during the duration of the unit; thus promoting the school's health and wellness initiative. The students who participate in the unit will display the data on a bulletin board where the rest of the school will have access to viewing it. If portable, this board will be sufficient for a science fair or other science-related activity.

Demographics

The students who will work on this project are predominately African-American urban youth living in the New Haven area. The students come from families of low socio-economic levels and have little interaction with computers. They are in third grade at the Barnard Environmental Studies Magnet School. Barnard is a school that services approximately 500 Pre-K through eighth grade students. The school's magnet focus is on environmental studies; therefore, it has a strong emphasis on integrated science and math education.

Since many of the students have little computer experience, this lesson will introduce them to computers connected to the Internet. The computers will allow the students to access the most current information on data analysis, graphical representation, and physical health and wellness. In addition, this unit reaches objectives from the New Haven Public School's third grade mathematics curriculum.

Strategies

In the *Are We Couch Potatoes or Busy Bees?* unit, students will follow the scientific method for the duration of this project. The scientific method will provide the basis for inquiry into the two main topics: data analysis/representation and physical health.

The project will begin with the students doing background research on child health, mainly physical activity; a possible additional topic could be the diet and its effect on health and well-being. This research will lead small groups of students to pick a question to analyze physical activity in the school setting. These questions may be derived from, but are not limited to, one of the following: stair climbing analysis measured in elevation as compared to a sky-rise building or mountain; distance traveled or number of steps walked measured on a map to show collective distance traveled from the school to a nearby city; inside versus outside classroom instruction; home free-time analysis of television, video game, or computer usage compared to amount of active play time; minutes doing Yoga compared to participants' perceived stress level; length of instructional time between physical activities; and so on. Other topics may include analysis of diet while eating school breakfasts and lunches; however, diet is not the primary focus of this unit.

At the conclusion of this initial background research, small student groups will decide on a hypothesis statement. They will declare an educated prediction about what they expect will be the result of their research. For example, a group researching Yoga and how it may help reduce stress might hypothesize, "If we participate in Yoga every day, we will feel less stress." During the experiment, the students could determine stress levels using survey data.

With their hypothesis in mind, the students will then begin testing their prediction. At this stage of the unit, students will need sufficient training on data collection through surveys, direct observations and measurements, and other means to get the information they need. The groups will carry out the entire data collection process including creating any surveys, observation tables, and/or measurement-reporting tables by other students.

When sufficient data are available, even if the data collection is ongoing, the students will begin to organize

the data into structured tables. Each group will transfer this data onto a computer spreadsheet program that is familiar to the group. Training on the use of any preferred spreadsheet program is important for students to realize success. The organized data in table form will then be converted to various graphs. With the aid of the teacher and other students, if possible, the students will analyze their graphs in an effort to draw conclusions about what they discover. This previous step requires much guidance for the students since the bulk of the data analysis goes on during this stage.

Last, and arguably most important, is the reporting results stage. The student groups will take their graphs, typed conclusions, and any other pertinent artifacts from their project and create a working bulletin board or project board. The purpose of this board is to present their conclusion in a clear format to any person who reads it; therefore, they must tailor their graphs to fit what various age groups may be able to understand. For instance, a Kindergartener may not be able to understand what information might be identified on a double-bar graph, but he may be able to understand a pictograph version of that same information.

By the time each student group finishes, the students will have working boards to be able to present to their classes or even use in a science fair. Through the use of the Scientific Method, the students gain knowledge about data analysis and graphical representation, physical health and well-being, and scientific inquiry -- it is a fully integrated approach to learning.

The Scientific Method:

Figure 1: Scientific Method diagram in cycle formula

1. Lesson One: Research

During this stage the student groups will conduct background research on child health and, in particular, physical activity in school. If the teacher and student group so choose, research may be done on diet and its effect on health and well-being.

An article entitled, “Active Education,” produced by a program of the Robert Wood Johnson Foundation, summarized over forty research studies that looked at children’s health, physical activity, and/or academic performance. The article stated that nearly 25 million children and teens are overweight or obese and that physical activity is linked to causing this epidemic. Estimates also indicate that only 4.6 percent of schools provide daily physical activity -- elementary schools were 3.8 percent, middle schools were 7.9 percent, while high schools dropped to 2.1 percent (See Fig. 2). [2]

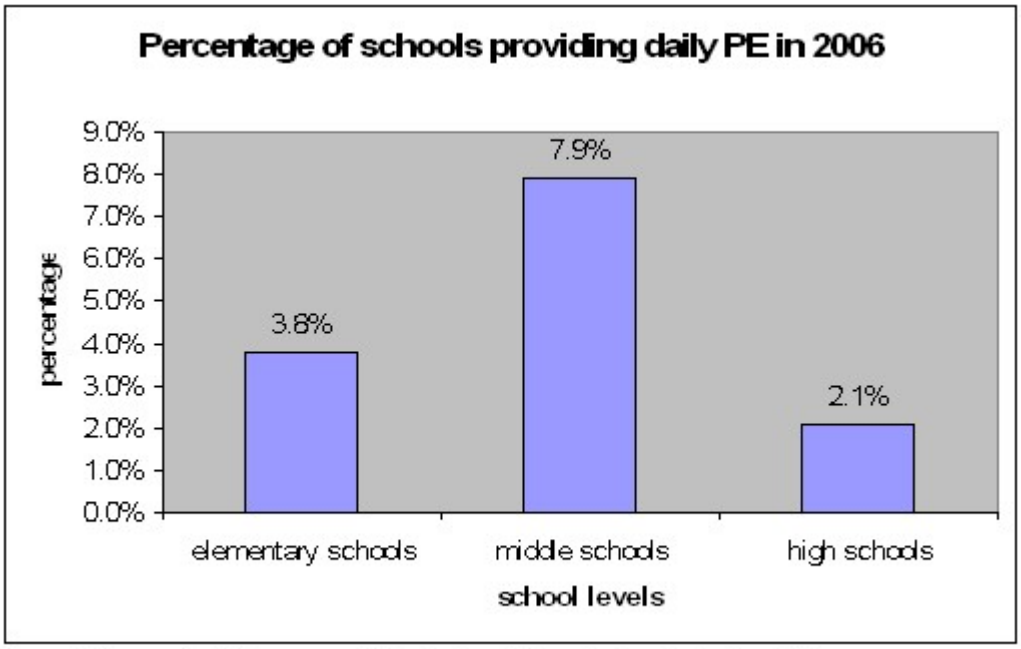

Figure 2: A graph of the percent of schools offering daily physical activity

The major finding of these studies was that, “Students whose time in [Physical Education] or school-based physical activity were increased maintained or improved their grades and scores on standardized achievement tests, even though they received less classroom instructional time than students in control groups.” [3]

A study published in *The Physical Educator* , attempts to clarify these previous findings that physical activity directly affects academic achievement in a positive way. The article points out that many studies have revealed a connection between students who participate in physical education on a regular basis and their academic performance; however, the authors of the article cannot justify that physical education directly improves academic achievement of students. They do state that physical education benefits motor skills and health. The article suggests that, “physical education programs should not be advocated as a means to promote academic achievement in students.” [4] In the very same issue of *The Physical Educator* , a separate article argues that physical education and activity should be integrated into other subject areas so that

students will get daily physical activity. The author of this article states that, “it has been found that exercise triggers the production and flow of BDNF (a brain-derived neurotrophic factor)…with increased BDNF circulating in the brain, a greater amount of neurons are able to exchange and retain information, enabling individuals to understand, comprehend, remember, and retrieve more information and at a quicker rate.” [5] Therefore, if each author’s findings are taken into consideration, one might conclude that mere physical activity is only the first stepping stone to increased academic performance. The answer to improving scores relies upon the integration of physical activity in the presence of learning. This finding is essential for teachers of this unit to convey to students before the problem-finding stage begins.

In this lesson, the teacher should provide computers with Internet access so that students can visit some of the various websites listed in the *Resources* section of this unit. The teacher should save each site as a link in the Internet browser so the students can jump right to the articles to read. Using a *Jig-Saw* strategy, the teacher might divide up the articles so each student group is in charge of reading and presenting one. When the reading time is through, each group would then report back to the class on the information they learned from the article.

2. Lesson Two: Finding a Problem

During the research component, the teacher must guide the students to produce one question that they would like to analyze. Students may have a difficult time creating a focused question during their research since they will probably be looking at a great deal of information. It is the teacher’s responsibility to make sure the resulting question contains only one variable to analyze; too many variables will complicate the data collection stage and will confuse the end conclusion. For example, a group might want to research how much a couple classes walk during a month of school. They may want to analyze the number of steps they take, the distance they travel, and how many shoes get worn out. In this case, the teacher may want to step in and help the group decide to measure number of steps or distance-traveled ideas since students might not wear out their shoes in one month of school walking. The teacher should also frame an example question like, “In one month, will my class walk far enough to to reach New York City?”

In this stage, the teacher must ask guiding questions to facilitate true scientific investigation and inquiry. An example question he/she might ask would be, “In what ways will your group be able to figure out how far your class has walked during your month?” The students must brainstorm about their topic by writing down or discussing what they are interested in investigating. The next step is to list the things that could be changed or varied as well as the things that could be measured or observed. From this discourse, the problem will develop. [6] Continuing with the class walking example, the students will change the distance the class walks by encouraging the teacher to take them outside for lessons or asking other students to walk to school instead of taking the bus. This group might ask the physical education teacher for pedometers to count the number of steps each student takes each day. The group could figure out what each student’s step distance is equivalent to in feet or meters. By adding up all the steps, the group could then calculate the distance of each student by multiplying his/her step distance. Adding up all of the students would then give the group a total distance. The data table below shows an example of what these numbers might look like:

Student Name	Number of Steps traveled		Step Distance		Total Distance
Suzie Q.	134	X	0.5 m	=	67.0 m
Jim D.	121	X	0.8 m	=	96.8 m
Frank L.	218	X	0.6 m	=	130.8 m
Sally B.	243	X	0.4 m	=	97.2 m
					Group TOTAL: 391.8 m

Figure 3: Walking distance data table example showing a total of nearly 400 meters of distance traveled by the combined-efforts of four students

3. Lesson Three: Creating a Hypothesis

After each group decides on a focused problem to analyze, they must take some time to do a little more research on that one area (i.e. distance from school to New York City). That research does not need to take much time since it is merely to give the students an idea as to what might be the answer. The possible answer will enable the students to create an "If…, then…" statement (i.e. If we encourage our class to walk, then we will walk a far enough distance to reach New York City from the school). This statement becomes the hypothesis for their project. It will be answered by the data they collect. Every effort must be made to make sure this hypothesis may be adequately proven one way or the other. Again, the teacher must guide students in creating a hypothesis that analyzes only one variable. The following information will help in providing the structure in developing a solid hypothesis.

To introduce variables, it is recommended that the students formulate statements like, "I will change…", "I will measure…", "I will not change (so that it is fair)…", and "I will not measure…" in order to identify the variables of the investigation in a kid-friendly way. The next step is to identify the students' predictions of the question, "When I change…what will happen to…?" Therefore, the students must answer this statement: "Based upon this question, I predict…" [7] These sentences clauses might be given to the students in the form of an activity sheet or written on a board for them to answer in science journals.

4. Lesson Four: Experiment -- Collect the Data

In this stage, the student groups will create baseline surveys and will choose a focus group to complete the surveys. The surveys should follow the following guidelines: they should be no more than five questions long, each question should quantify the data in the same way (i.e. the use of a Likert Scale is preferred), and finally each student should be able to complete the survey in one sitting. Some surveys may include perceived data based on the student perspectives; other surveys may ask more quantifiable information such as: "In school, how many minutes a day do you go outside?" To clarify, a Likert scale is defined as, "a psychometric response scale often used in questionnaires, and is the most widely used scale in survey research…[In it] respondents

specify their level of agreement to a statement." [8]

Likert Survey Example:

1. I walk a lot in school.				
Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
o	o	o	o	o
2. I exercise at least 3 times per week.				
Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
o	o	o	o	o

Figure 4: Example of Likert survey questions (question 1 elicits a perceived response, while question 2 elicits a quantifiable response) -- many surveys have smiley faces instead of the words; the smiley faces range from a smile to a frown and help those students who have trouble reading

Direct observation may take place in the experimentation stage, as well. During direct observation, each student group must have a table ready-to-go to be able to record the data in a timely fashion. The student groups may consider creating tables for data collection that the focus groups can complete, as well. For instance, a class might be able to log how many steps they take during the school day -- especially if the teacher is keeping track of it with the class (please refer to *Figure 3* for an example of this table).

5. Lesson Five: Compile Data -- Organize the Information Visually

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Each student must decide whether they are going to collect data at scheduled check-points or at an endpoint. It is the author's opinion that this unit should be on-going and, therefore, data should be collected multiple times so that focus groups might consider improving their behaviors. This data should be logged into a computer-graphing program or spreadsheet that has graphing capability.

In this lesson, the teacher must go into detail on all the various types of graphs that must be taught in the curriculum. It will, therefore, take multiple classroom sessions. Students learn best by doing, so with each graph explanation the students should be given time to create and analyze graphs of that kind. Eventually, the student groups must decide which graph or graphs will best represent the information that they have gathered for their project. For example, the distance-walking graph might be a line graph that shows distance on the y-axis and time on the x-axis. It might also have a picture of the school near the (0,0) coordinate where the walking begins and a picture of New York City in line with the actual distance to the city. The graph would show how much farther the class has to travel to reach the goal. For an example of this type of graph, please refer to Line Graphs below.

Graphs & Plots

Using the same data, students should create multiple kinds graphs to be able to reach as many students as

they can. The younger grades will understand simpler graphs and the older grades, more complicated ones. It is important to understand the definition of graphical data first before one should expect to teach children how to best use them. As Edward Tufte explains in his book, "The Visual Display of Quantitative Information," "Data graphics visually display measured quantities by means of the combined use of points, lines, a coordinate system, numbers, symbols, words, shading, and color". [9]

An important factor in teaching someone how to make a graph is making sure that he/she knows the *Principles of Graphical Excellence* since a poorly made graph is sometimes worse than no graph at all. Tufte defines graphical excellence in the following ways: "Graphical excellence is the well-designed presentation of interesting data -- a matter of *substance* , of *statistics* , and of *design* … [It] consists of complex ideas communicated with clarity, precision, and efficiency…[and it] is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space." He adds that three skills must be learned in order to produce what he calls, "graphical competence," "the substantive, statistical, and artistic." Each subsequent skill adds a key element in any well-designed graph. Much of these ideas might be lost by a teacher who thinks that her students are too young for such demands; however, it is the author's belief that even the youngest of children can learn the skills to create graphical excellence. And certainly to understand a graph to its fullest, one would appreciate the data after such training. [10]

The book, "Math on Call," is an excellent resource for any teacher who needs support in teaching graphs as well as any student who needs a quick guide on how to create a particular graph. More details on each graph described in the next sections may be found in this book. [11] The following sections will go into detail on a series of graphs commonly part of a third grade elementary mathematics curriculum; however, it is worth mentioning that this unit is not meant to teach all of these types of graphs at one time:

Pictograph

A "Pictograph is a way of representing statistical data using symbolic figures to match the frequencies of different kinds of data." [12]

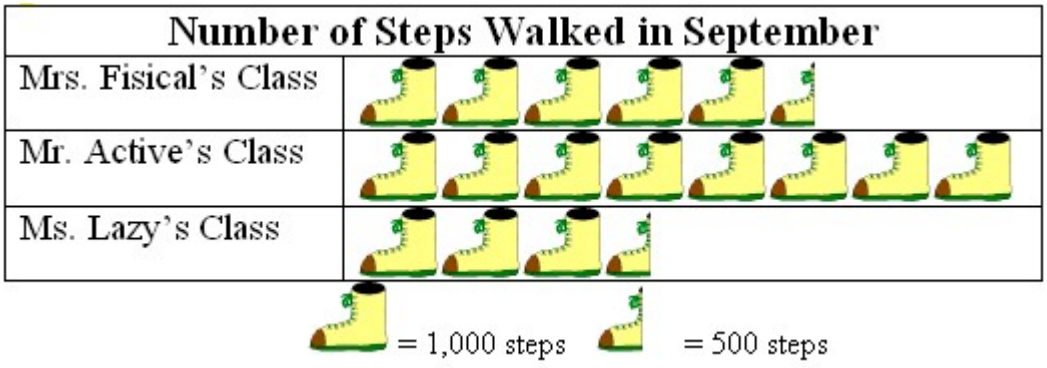


Figure 5: Example of a pictograph

After reading the graph above, one can see the following results: Mrs. Fisical's class walked 5,500 steps, Mr. Active's class walked 8,000 steps, and Ms. Lazy's class walked 3,500 steps. This particular graph can be worked on as the month progresses so classes can see how many steps they are walking.

Bar Graph & Double Bar Graph

A bar graph, also known as a bar chart, "is a chart with rectangular bars of lengths proportional to that value that they represent. Bar charts are used for comparing two or more values. The bars can be horizontally or vertically oriented. Sometimes a stretched graphic is used instead of a solid bar." [13] Bar graphs are useful because they display data in an easy-to-understand way.

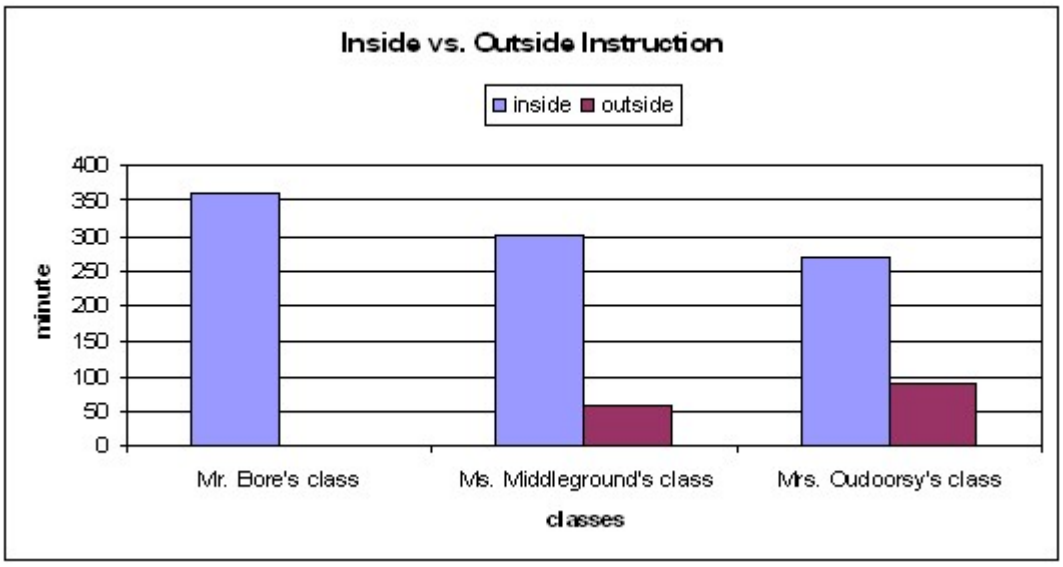


Figure 6: Example of a double bar graph that measures inside versus outside instruction time in three classrooms

Line Plot

A line plot is an easy way to organize data. This type of graph "consists of a horizontal number line, on which each value of a set is denoted by an x over the corresponding value on the number line. The number of x's above each score indicate how many times each score occurred." [14] In some cases, this graph may be referred to as a histogram.

Number of times I did Yoga at home										
			X							
			X		X					
			X	X	X		X			
		X	X	X	X		X		X	
X		X	X	X	X		X	X	X	X
0	1	2	3	4	5	6	7	8	9	10

Figure 7: Example of a line plot that measures the number of times individual students practiced Yoga at home

Line Graph & Double Line Graph

"Line graphs compare two variables. Each variable is plotted along an axis. A line graph has a vertical axis and a horizontal axis." [15] In many cases, the x-axis in a line graph denotes time.

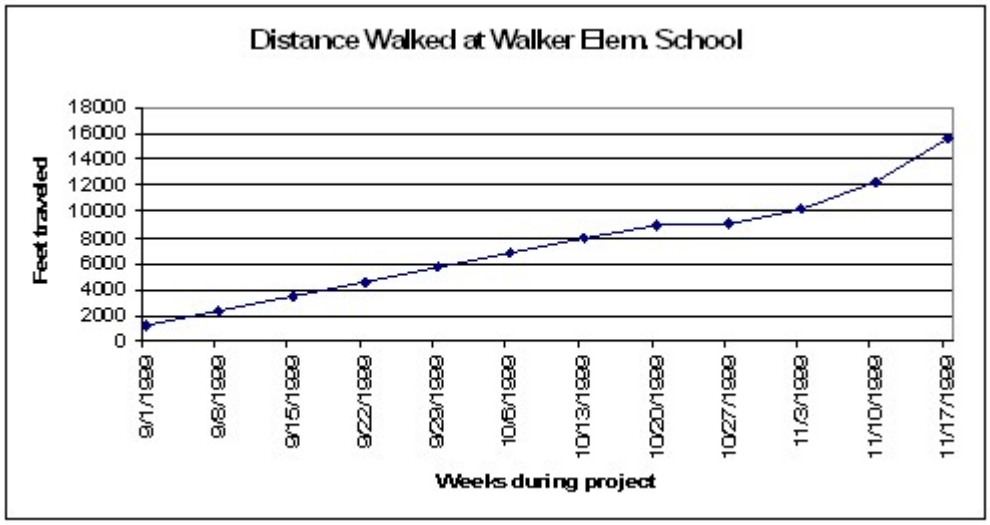


Figure 8: Example of a line graph showing the distance traveled by foot while walking in school

Pie Chart

Pie Charts, also known as circle graphs, display percentages and are used to compare different parts of the same whole. [16]

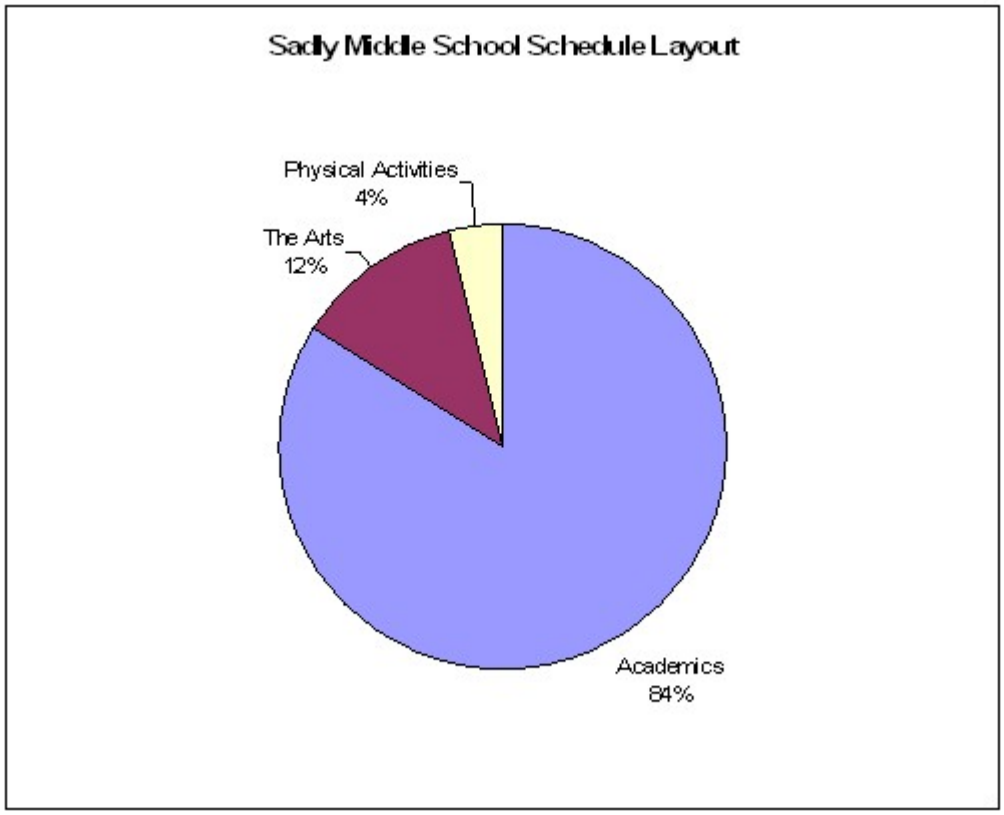


Figure 9: Example of a pie chart that divides up the schedule of activities for an average week at Sadly Middle School

Scatter Plot

The scatter plot is similar to the line graph; however, the purpose of the scatter plot is to show how much one variable is affected by another. This relationship is called their correlation. If both X and Y variable increase together the variables are said to have a positive correlation. If one increases while the other decreases, the variables are said to have a negative correlation. [17]

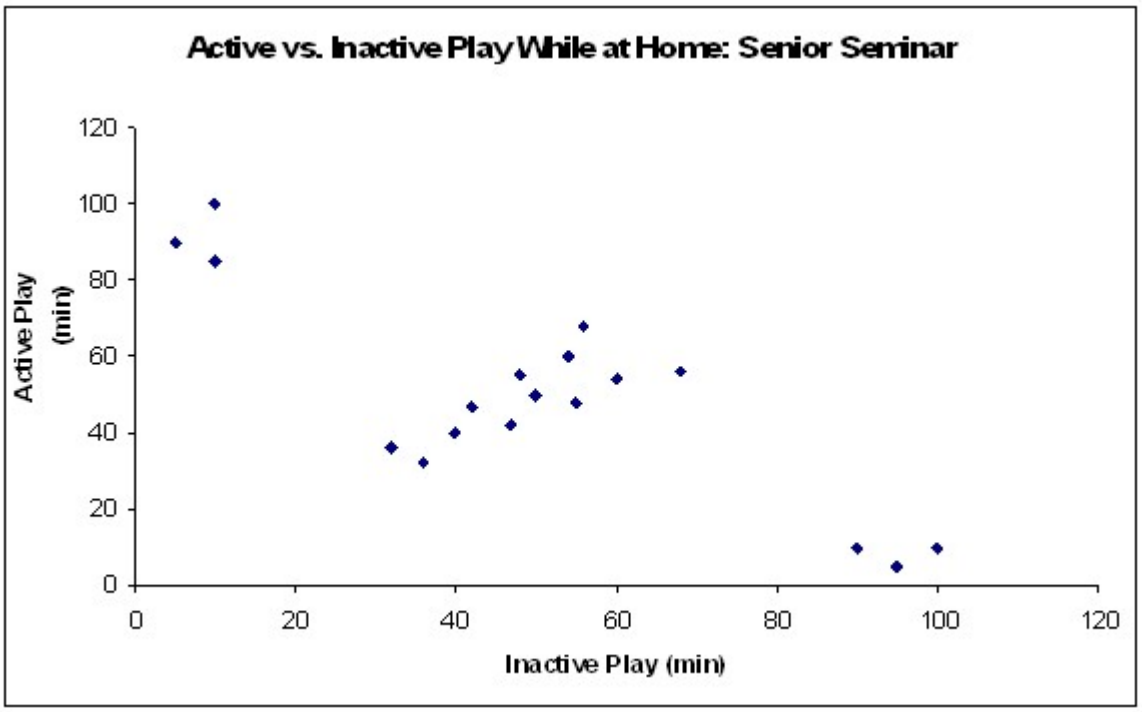


Figure 10: Example of a scatter plot comparing active versus inactive play for “example” high school seniors while at home; the middle values suggest a positive correlation between active and inactive play when calculating total amount of play time

Stem-And-Leaf Plot

The stem-and-leaf plot is similar to the line plot; however, the number line is usually vertical and digits are used instead of x’s. [18]

Consider that a class measures student heart rates after physical activity; the raw data of such an event might look something like the following list after ordering the beats per minute from least to greatest:

61, 84, 86, 88, 92, 99, 99, 99, 113, 114, 121, 122, 124, 124, 127, 129, 138, 144, 147, 148, 151

A stem-and-leaf plot takes this raw data and organizes it in a way that visually makes more sense. This type of plot also makes finding mean, median, and mode much easier than looking at a random list of data. For example, just from looking at the stem-and-leaf plot one can see that the mean of this data will be somewhere around 115; the actual mean is 114.8. The median is 121. The mode is 99. A stem-and-leaf plot can also be a

quick paper and pencil display of data while preserving all data points.

Student Heart Rates after doing 1 minute of jumping jacks	
Stem	Leaf
6	1
7	
8	4 6 8
9	2 9 9 9
10	
11	3 4
12	1 2 4 4 7 9
13	8
14	4 7 8
15	1

Key: 6 | 1 = 61

Figure 11: Example of a stem-and-leaf plot that shows a class' breakdown of heart rates after physical activity

6. Lesson Six: Forming Conclusions

After looking at a graph, students may find it difficult not to draw a conclusion. Since many of the groups will be creating on-going graphs, the act of analyzing the data will also be on-going. Depending on the level of the students working on the project, the teacher will need to model appropriate ways to extract conclusions from a graph.

In this lesson, the teacher must provide real-life examples of graphs in newspaper and magazine print form. With many examples of different types of graphs, the teacher will be able to address each of the curricular areas. Occasionally, printed graphs do not follow the same rules as are taught in school. The teacher should decide whether or not to address this issue. Students talk with each other during this activity because it will get them thinking more about analyzing graphs. After time has been given for dialogue and discussion, have groups present their discoveries to the rest of the group. If each group has different graphs, the teacher must plan a way that the whole class will be able to see each graph clearly during the presentation stage.

Reporting Project Results

The students will want to report the results in some way so that the focus groups will be able to see the data. Most notably, the students may want to consider displaying the same data set in multiple ways. The "National Council of Teachers of Mathematics (NCTM) Standards encourages teachers and students to explore multiple

approaches and representations when engaging in mathematical activities." [19] Thus providing a bar graph as well as a pictograph may encourage students from multiple grade levels and skill levels to understand and interpret the information.

An interactive bulletin board located in a convenient spot in the school is the ideal way to report results, especially since the goal is to promote physical activity -- classes will inadvertently want to compete to improve their physical activity. Another way to report the results would be for each group to create a project board (i.e. science fair-type tri-fold board). This type of board is ideal for any student group who needs to be able to transport their results to multiple locations in a school and even to a science fair.

Teachers should encourage students to present their findings to their classes as well as any focus groups who might be interested in the results. An ideal setting would be an assembly with the whole school where the students could present their results and have the greatest impact.

Steps 7 & 8. Finding an Answer or another Problem

Depending on each student group's findings, their last step may differ. Some groups will find an answer to their hypothesis thus proving it correct or false. Other groups will find that their hypothesis only produces another problem. Either way, the teacher's responsibility is to point out that the Scientific Method is usually an on-going process; very few times do scientists come to an end point in their research and experimentation. The idea for this unit is for students to learn appropriate ways to improve their health and well-being as well as a graphical way to analyze the improvement.

Classroom Activities

The classroom activities are explained throughout the unit; however, a set of activity sheets immediately follow this section. In these activity sheets, the students go through a microcosmic example of the whole unit: they complete pre- and post-surveys, fill out data tables, create a double-bar graph, analyze the data, and do so in a scientific method process.

How do our heart rates change from resting to jogging?

Pre-Survey -- circle your response that best matches how you feel right now:

1.) I am alert and ready to learn.

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
1	2	3	4	5

2.) I am thinking clearly.

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
1	2	3	4	5

Background Information:

Your carotid artery is the artery that brings blood from your heart to your brain. It pulses each time your heart beats. To feel your pulse, put your index and middle fingers together, place the fingertips directly under your

ear, and then slide them down until they're right under your jawbone. If you press lightly, you'll feel the pulse. Make that you don't press too hard; you should push just enough to feel the pulse. If you don't find it, try a different spot.

Activity:

1. Count the number of heart beats in one minute while you are sitting at your desk
2. Write the number on line 1 of the **Resting Data Table**
3. Find the results of four other students and write them in on lines 2-5
4. Tell a partner what you think will happen to your heart rate when you start jogging -- hypothesis
5. Begin jogging in place
6. When your teacher tells you, begin taking your pulse again
7. Write the number on line 1 of the **Jogging Data Table**
8. Find the results of four other students and write them in on lines 2-5

Resting Data Table

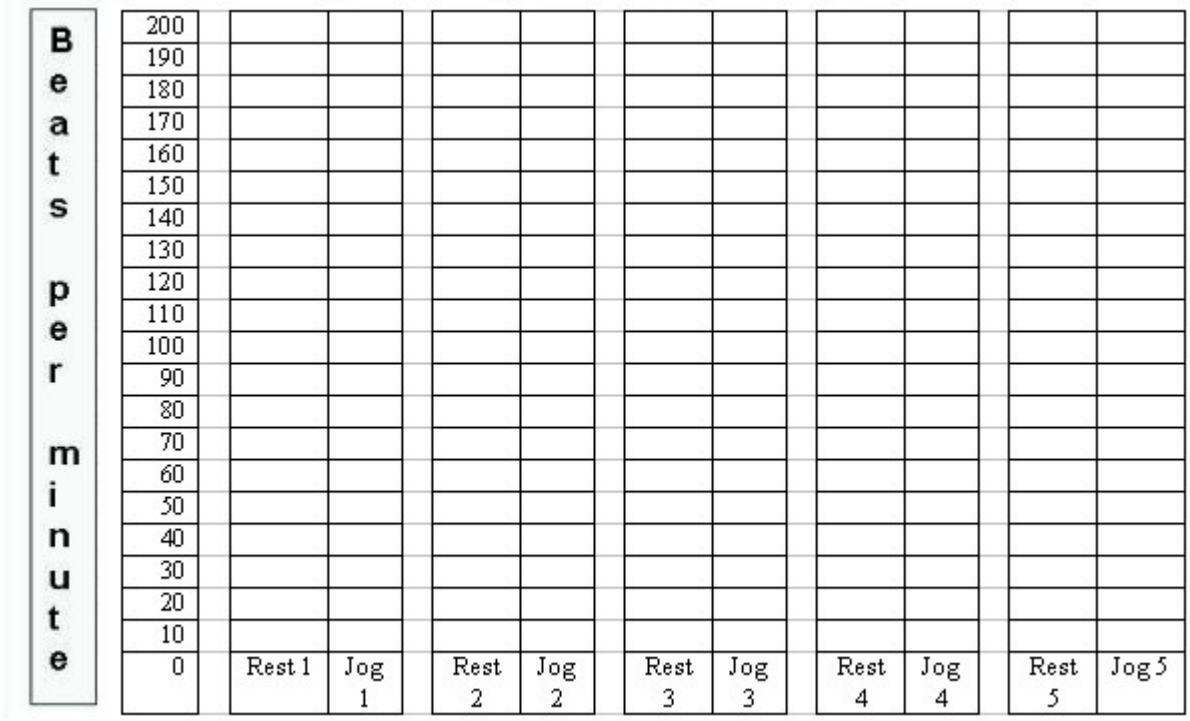
Student Names	Beats per min.
1)	
2)	
3)	
4)	
5)	

Jogging Data Table

Student Names	Beats per min.
1)	
2)	
3)	
4)	
5)	

Graph Your Results -- Complete this double-bar graph by shading in the correct number of boxes for each student; use one color for **Rest** and another for **Jog**

Title:_____



Students

Graphing Questions -- Answer the following questions in complete sentences:

1. How is the jogging rate different from the resting rate?

_____

_____

2. How would you change this activity to make it better?

_____

_____

Post-Survey -- circle your response that best matches how you feel now:

1.) I am alert and ready to learn.

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
1	2	3	4	5

2.) I am thinking clearly.

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
1	2	3	4	5

Question to Ponder: In what ways did your survey answers change?

Reference Materials

Teacher's Resources:

Bernstein, A. (1999).Great graphing grabs students' attention. *Library Talk* . 26.

Gunter, P. L., Miller, K. A., Venn, M. L., Thomas, K, & House, S (2002). Self-Graphing to success: Computerized data management. *Council for Exceptional Children* . *35* , 30-34.

Kaplan, A. (1998). *Math on call* . Wilmington, MA: Great Source Education Group, Inc.

KidsHealth, (2006). Personal health series: Fitness. Retrieved April 7, 2008, from KidsHealth in the Classroom Web site: http://classroom.kidshealth.org/classroom/3to5/personal/fitness/fitness.pdf

Tufte, E. R. (2007). *The visual display of quantitative information: Second edition* . Cheshire, Connecticut: Graphics Press LLC.

*Below are descriptions of Computer Spreadsheet and/or Graphing Programs:

Microsoft Excel

Microsoft's spreadsheet program, Excel, is one of the most commonly-used spreadsheet programs in public schools. The basic layout is a grid-system where the user inputs raw data onto the grid in table format. The table may then be highlighted and a graph created based on the type of data being analyzed. For example, to create a basic bar graph using two categories of data, the category names should be typed under the A-column one on top of the other. The data should then stem off of each respective category under the name of the data (label) located on the first row under the B-column:

	Students who ran 1 mile in less than 10 min.
Mrs. Smith's Class	11
Mr. Johnson's Class	9

Figure 12: Example of Excel spreadsheet table

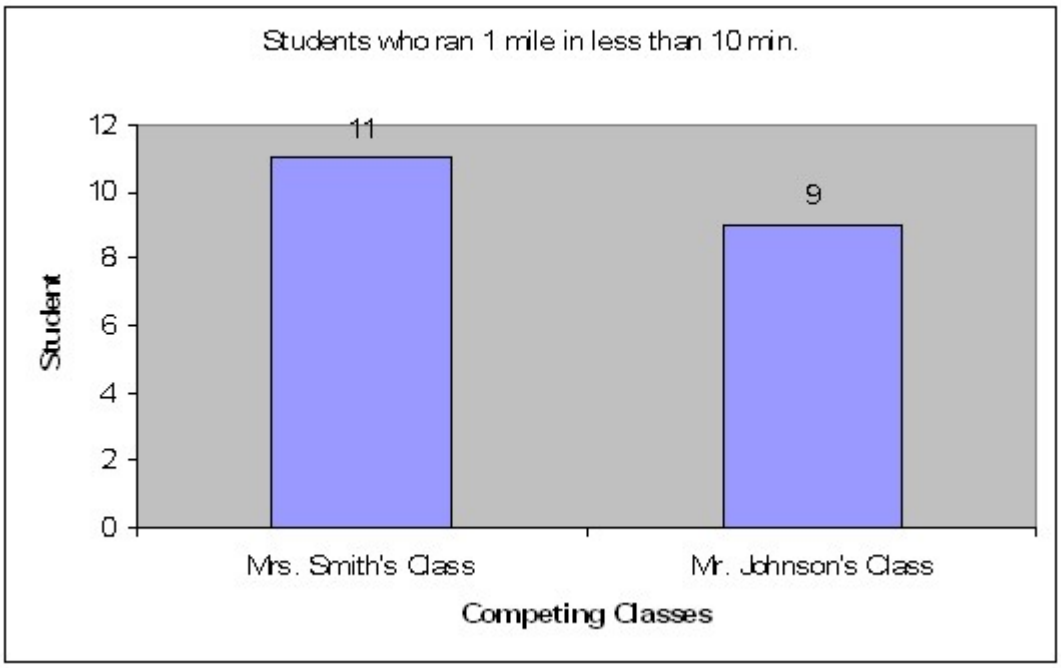


Figure 13: Example of Excel spreadsheet bar graph using the data table in *Figure 12*

National Library of Virtual Manipulatives Online

This Online resource is one of many different Websites that allow the user to input data into a form or grid; the site then produces a graph of the user's choice. This type of graphical representation is highly motivating for students because it is so user-friendly. Currently the NLVM allows for the creation of bar charts, pie charts, and scatter plots, just to name the few that match with this unit. [20] The only way to save a graph after creating one is to download the program to the computer. If a student creates a graph online, he can only print it out using the computer's print screen function.

Create-A-Graph Online

The National Center for Education Statistics (NCES) also created an online graphing resource: *Create-A-Graph* . Its format is similar to that of the NLVM Website; however, because *Create-A-Graph* is a spin off of the U.S. Department of Education, it attempts to guide and teach in a student-friendly environment. This program allows for the creation of bar graphs, line graphs, and pie charts. [21]

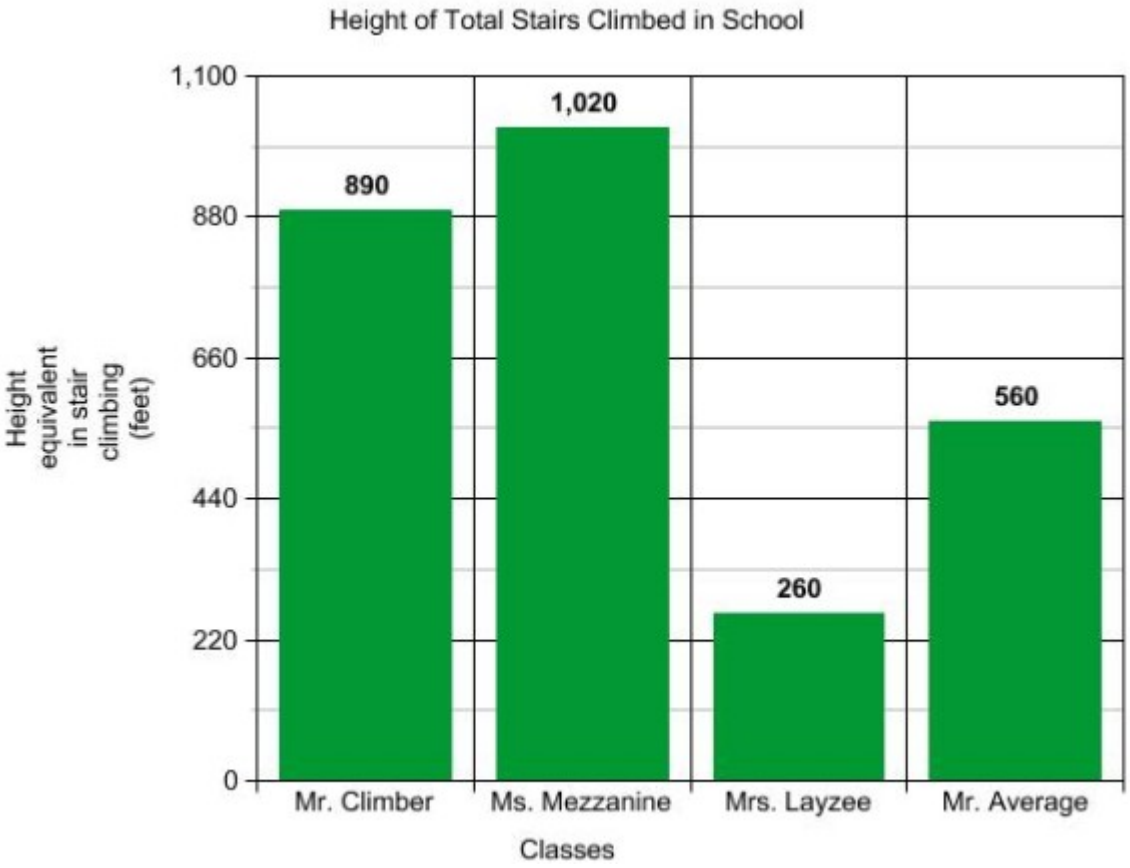


Figure 14: Example of a Create-A-Graph bar graph

Shodor Interactive

Shodor Education Foundation, Inc. adds its expertise to the mix with *Interactive* , a Website devoted to providing a means to produce various types of mathematical graphical representations. This resource is geared toward older students in advanced mathematics classes; however, younger students may still utilize its resource capability. The matching graphs that *Interactive* help create include bar graphs, circle graphs/pie charts, multi-bar graphs, stem-and-leaf plots, and scatter plots. [22] Shodor Interactive is only an online activity; therefore, the student must use the print screen option on his/her computer if he/she wants to save a copy of the graph.

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