

Janet Platt
Boston Day and Evening Academy
20 Kearsarge Ave.
Roxbury, MA 02119
617-635-8166
jplatt@boston.k12.ma.us

The Mathematics of Space and Place

...a math unit for 9th and 10th graders who are developing and improving their 8th grade skills while they study algebra, geometry and trigonometry

After completing this unit, students will be able to:

- Estimate linear dimensions and area by pacing
- Draw a map (to scale) of one block
- Use percent to make a circle graph (pie chart) of neighborhood use
- Collect data and use it to draw conclusions

Summary

Students will use pace as a measuring tool to draw the school yard and city blocks to scale, and to analyze the use of property and other space in a block or two of the city. Property use will be categorized, converted to percent, and presented in a pie graph.

Assessment

Students will produce and present to the class a scale map and pie graph showing a block or two of Boston and the use of property in that space.

Introduction

“*What does community mean?*” is our Essential Question this year at Boston Day and Evening Academy. In math class, we will start the year in a very concrete way by examining the role of PLACE in community, and trying to quantify a place. We will measure and draw to scale our schoolyard, then a bustling square near our school. We will use the data to describe the types of businesses and activities that occur in that place. Concurrently in Humanities class, students will interview area residents and business owners to discover the history of the school’s neighborhood. In Science class, students will care for and harvest the school’s garden as they study plant chemistry. Although our program is not truly interdisciplinary, we have a definite school-wide focus this year on community and place.

Classes are planned for 60 minute blocks. BDEA has four days of academic classes each week. Therefore, I would plan Day 1 for the last day of a week in order to have days 2–5 consecutive in the following week, then days 6–9, and finally the assessment during days 10–13. My students will be in groups of four, but the work must be able to

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be done when one or two group members are absent, and except for the class map, I expect all work to be done by all students (not just one copy for the group.) At BDEA, we have adults that can accompany my classes on out-of-building activities.

Unit Outline

Day 1: Memory Map

- Student Will Be Able To:** - draw a map of a place they know and identify key elements.
(SWBAT) - share a place they know with new classmates and find out about the places their classmates know.
- calculate mean, median, and mode.

| Time | Activity | Resources needed |
|-------------|-----------------|-------------------------|
|-------------|-----------------|-------------------------|

| | | |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Day 1 20 min | <u>Draw a Memory Map</u> <i>Students will draw a map of a place they know, from memory, and include these elements:</i> <ul style="list-style-type: none"> • 3 human-made things • 3 naturally occurring things • 3 memories | <ul style="list-style-type: none"> ▶ plain drawing paper ▶ colored pencils |
| 20 min | <u>Share Memory Map</u> <i>Students share maps with their groups of four.</i> | |
| 15 min | <u>Notes: mean, median, mode</u> | Notes for day 1 |
| 5 + HW | <u>Practice 1: Find mean, median, mode</u> <i>Start in class, finish for HW.</i> | ▶ Practice 1 <find a practice assignment on Mean, Median, and Mode> |

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Days 2–3: Measure Your Pace

- SWBAT: - measure the length of one step when he/she walks at a “normal” speed.
 - use “mean” to average the results of several trials.
 - write a personal pace ratio between the distance covered and the number of steps, and reduce that ratio to a unit ratio.

| Time | Activity | Resources needed |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Day 2 5 min | <u>Check Practice 1 answers</u> <i>Students can self-check answers.</i> | <create an answer key on transparency> |
| 10 min | <u>Pin Yourself On Boston Map</u> <i>Color-code pins by class group and have each student put a pin in where they live.</i> | <ul style="list-style-type: none"> ▶ Map of Boston on tackboard or foamcore ▶ map pins or flags |
| 10 min | <u>Notes: Pace and Personal Pace Ratio</u> | Notes for day 2 |
| 10 min | <u>Discuss Field Activity A: Measuring Pace</u> | Field Activity A sheet <ul style="list-style-type: none"> ▶ clipboards or folders |
| 20 min | <u>Field work</u> <i>complete 3 trials for each of 3 lengths and record data in table.</i> | <parking lot or other area with 3 lengths taped off and labeled: 15ft, 25 ft, 60 ft> <ul style="list-style-type: none"> ▶ extra adult for assistance |

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| | | |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 min | <u>Return to room</u> | |
| Day 3 15 min | <u>Notes: Convert Steps to Feet</u> <i>Give particular attention to cancelling units.</i> | Notes for day 3 |
| 20 min | <u>Field work</u> <i>Walk two more measured and labeled lengths, 3 trials each, and record data.</i> <i>Also walk off three unlabeled lengths, 2 trials each, and record the number of steps – these will be used later to estimate the length.</i> | Field Activity A sheet <from yesterday> ▶ clipboards or folders ▶ extra adult for assistance <parking lot or other area with 2 lengths taped off and labeled: 18ft, 40ft and 3 lengths taped off but NOT labeled: 52ft, 29ft, 34ft> |
| 15 min | <u>Complete Field Activity A: Measuring Pace</u> <i>In class, students can choose a structured approach, or a more challenging format.</i> | ▶ calculators |
| 10 + HW | <u>Practice 2: Convert Steps to Feet</u> <i>Start in class; continue for HW if necessary.</i> | Practice 2 worksheet ▶ calculators |

Days 4–5: Use Pace as a Measurement Tool to Map the Schoolyard

- SWBAT: - use personal pace ratio to measure the length of walls, fences, etc.
- draw a scale map of the school building, garden, and yard on graph paper.

| Time | Activity | Resources needed |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Day 4 15 min | <u>Notes: Scale and Scale Drawing</u> <i>Check Practice 2 while students copy notes. These notes could be photocopied and distributed, then the class could do a scale-drawing of the classroom on ¼" graph paper following the steps in the notes.</i> | Notes for day 4 |
| 15 min | <u>Discuss Field Activity B: Scale Drawing of the Schoolyard</u> | Field Activity B sheet ▶ clipboards or folders ▶ ¼" graph paper |

| | | |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| 25 min | <u>Field work</u> <i>Today, students should SKETCH the school and yard, and begin pacing off the lengths.</i> | ▶ extra adult for assistance <provide sketches for students who are stuck.> |
| 5 min | <u>Return to room</u> <i>HW: finish pacing; convert steps to feet.</i> | |
| Day 5 15 min | <u>Questions? Issues? Concerns?</u> <i>Such as, how will we handle the angle of the bend in the middle of the building?</i> | |
| 45 + HW | <u>Complete Field Activity B: Scale Drawing of the Schoolyard</u> <i>Incomplete work can be completed for HW.</i> | Field Activity B sheet <from yesterday> ▶ clipboards or folders ▶ extra adult for assistance ▶ 1/4" graph paper |

Days 6–9: Use Pace to Analyze Dudley Square Property Use

- SWBAT: - measure the street frontage of property using personal pace ratio.
 - group properties by category (e.g. clothes shop, food, green space).
 - establish usage percent for each category.
 - create a circle graph to show how the property space is used.

| Time | Activity | Resources needed |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Day 6 10 min | <u>Make pie graph of properties in Dudley Square</u> <i>This is to be done by estimating from memory.</i> | |
| 15 min | <u>Notes: Pie Graphs</u> | Notes for day 6 |
| 25 min | <u>Discuss & Start Field Activity C: Analyze Dudley</u> <i>Assign streets and blocks to groups, go over Ground Rules, discuss why we are using linear "frontage" rather than area. (It's easier to do, and it gives a sense of how space is allocated.)</i> | Field Activity C sheet ▶ photocopy of map of Dudley Square |

| | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>10 + HW</p> | <p><u>Practice 3: Pie Graphs</u> <i>Start in class, finish for HW if necessary</i></p> | <p>▶Practice 3 <find a practice assignment on <u>creating</u> pie graphs> ▶protractors</p> |
| <p>Day 7 10 min 5 min 35 min 10 min</p> | <p><u>Questions? Issues? Concerns?</u> <i>For example, what will we do about ...2nd and 3rd storey buildings and businesses? ...doorways that lead to staircases? ...driveways?</i></p> <p><u>Check street assignments</u> <i>Remind students that</i> >each student must complete his or her own pacing and worksheet. >groups must stay together. >we will meet at (<u>place</u>) at (<u>time</u>).</p> <p><u>Field work</u></p> <p><u>Return to classroom</u> <i>HW: finish pacing assigned block.</i></p> | <p>Field Activity C sheet <from yesterday> ▶clipboards or folders ▶extra adult for assistance</p> |
| <p>Day 8 10 min 10 min</p> | <p><u>Check Practice 3: Pie Graphs</u> <i>Students can self-check HW</i></p> <p><u>Establish initial categories for your street</u> <i>Each group should decide on categories for the properties on their block, such as fast food, clothing stores, etc.</i></p> | <p><create answer transparency> Field Activity C sheet <from yesterday></p> |

| <p>15 min</p> | <p><u>Establish categories for the whole class to use</u></p> <p><i>All groups list their categories on one piece of chart paper. The whole class works to eliminate redundancies and categories that are too narrow. If necessary, the group can dot vote (each person gets 3-5 dots to place by the categories they like... the categories with the most dots stay) in order to condense categories. There can always be a "miscellaneous" or "other" category.</i></p> | <ul style="list-style-type: none"> ▶ chart paper and markers ▶ adhesive dots | | | | | | |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|----------|-----------------|--|--|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>25 min</p> | <p><u>Compile Data: One Table and Map, many Pies</u></p> <p><i>Three activities complete Field Activity C. Number 1 must be finished before anyone can begin number 2, but students can work on making and labeling the map at any time.</i></p> <p>① Create one giant table for each category:</p> <table border="1" data-bbox="370 997 1015 1102"> <thead> <tr> <th>group</th> <th>property</th> <th>length (in ft.)</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table> <p>Total length (in ft.) for category: _____</p> <p>② Once the category charts are complete, students can use the data on side 2 of the Field Activity C sheet to make a pie chart.</p> <p>③ Also, each group will label a giant map of Dudley with the properties they measured. <The map can be created by using a transparency of a Dudley map to enlarge it onto chart paper.></p> | group | property | length (in ft.) | | | | <ul style="list-style-type: none"> ▶ chart paper and markers ▶ 1"-grid easel paper ▶ protractors ▶ rulers ▶ compasses or circles |
| group | property | length (in ft.) | | | | | | |
| | | | | | | | | |
| <p>Day 9</p> <p>60 min</p> | <p><u>Complete the Analysis of Dudley Square</u></p> <p><i>This day provides time to finish the project: complete charts, pie graphs, and map. I also hope to introduce next week's assessment.</i></p> | <p>See above.</p> | | | | | | |

Days 10–13: ASSESSMENT → Analyze Your Place

- SWBAT:**
- demonstrate mastery of the following skills
 - measure length using personal pace ratio
 - draw a scale map
 - create a circle graph, using percent, to show space utilization

| Time | Activity | Resources needed |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| <p>Day 10 20 min</p> | <p><u>Introduce the Assessment</u> <i>The assessment is like the Dudley activity, but now students will analyze a block in Boston (that they live near). The requirements are listed on the assessment sheet.</i></p> | <p>Assessment sheet</p> |
| <p>40 min</p> | <p><u>Help students get organized</u> <i>In the Dudley activity, structure was provided. For the assessment, students will be responsible for making their own tables and graphs. During this time, students can begin by deciding the street and block they will analyze, making their data collection tables, and by listing the properties they know in the tables.</i></p> <p><i>I will also have students list the street (and later the addresses on the block) that they will be analyzing.</i></p> <p>HW: pace the block and collect data! The rest of the assessment can not go forward without the data.</p> | <ul style="list-style-type: none"> ▸ lined paper ▸ graph paper |

| | | |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Days 11, 12 and 13 | <u>Work on and finish Assessment</u> <i>Students who have collected data should be able to make a table of properties grouped by category and calculate percentages for each category.</i> <i>The other two things to do are make the pie graph and the scale drawing.</i> <i>Students who do not have data will work on skill worksheets until they bring in data.</i> | <ul style="list-style-type: none">▶ lined paper▶ graph paper▶ rulers▶ calculators▶ protractors▶ circles or compasses▶ <make skill practice worksheets for students who did not collect data.> |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

MA State Framework Connections

The frameworks addressed directly in this unit are:

- 10.N.4** Use estimation to judge the reasonableness of results of computations and of solutions to problems involving real numbers.
- 10.M.1** Calculate perimeter, circumference, and area of common geometric figures such as parallelograms, trapezoids, circles, and triangles.
- 10.D.1** Select, create, and interpret an appropriate graphical representation (e.g., scatterplot, table, stem-and-leaf plots, box-and-whisker plots, circle graph, line graph, and line plot) for a set of data and use appropriate statistics (e.g., mean, median, range, and mode) to communicate information about the data. Use these notions to compare different sets of data.

Additionally, data and skills from this unit set the stage for further study using these frameworks:

- 10.P.2** Demonstrate an understanding of the relationship between various representations of a line. Determine a line's slope and x- and y-intercepts from its graph or from a linear equation that represents the line. Find a linear equation describing a line from a graph or a geometric description of the line, e.g., by using the "point-slope" or "slope y-intercept" formulas. Explain the significance of a positive, negative, zero, or undefined slope.
- 10.P.7** Solve everyday problems that can be modeled using linear, reciprocal, quadratic, or exponential functions. Apply appropriate tabular, graphical, or symbolic methods to the solution. Include compound interest, and direct and inverse variation problems. Use technology when appropriate.
- 10.G.5** Solve simple triangle problems using the triangle angle sum property and/or the Pythagorean theorem.
- 10.G.7** Using rectangular coordinates, calculate midpoints of segments, slopes of lines and segments, and distances between two points, and apply the results to the solutions of problems.
- 10.M.2** Given the formula, find the lateral area, surface area, and volume of prisms, pyramids, spheres, cylinders, and cones, e.g., find the volume of a sphere with a specified surface area.

Acknowledgments

None of the material in this paper was taken from books or other written sources. However, I did not create the big ideas here myself.

Lisa Rioles Collins shared her pacing ideas (and many other wonderful thoughts) with me and convinced me to use pacing in my practice.

Brooklyn Center for the Urban Environment and **The Walden Woods Project** both taught me similar mapping activities to use with students.

Supplementary Materials

Class Notes

Class notes are presented in a modified Cornell Note-taking format in which the topic is listed in the left column. The right column contains the details, examples and other information. In a true Cornell system, the left column is left blank for the student to summarize and draw out pertinent information, but these notes are for students learning to use a new note-taking system. Class notes are formatted so they can be printed out on transparencies to reveal slowly, or written onto the board as students copy them.

<Notes to the teacher are typed in smaller font.>

Practice Worksheets

Practice 1, involving Mean, Median, and Mode can be taken from a middle school or algebra textbook. Practice 3: Making a Pie Graph, can also be taken from another source. The other skill-building worksheet is included. Practice sheets are meant to be finished as homework, but could be used entirely during class.

Practice 2: Converting Steps to Feet

Field Activity Sheets

These copy-masters contain instructions and formatted space for data collection.

Field Activity A: Measuring Pace

Field Activity B: Scale Drawing of the Schoolyard

Field Activity C: Analyzing Dudley Square

Assessment: Analyze Your Place

This is the student requirement sheet for the unit's assessment. Since Boston Day and Evening Academy is competency based, a list of skills is included rather than a grading rubric.

<date>

<Notes for day 1>

Measure of Central
Tendency
(a.k.a. Average)

def/ these are ways of trying to find the center of the data, or a number that is closest to all of the numbers in the data. (The word “average” could refer to any of the three measures, but most often is used to represent “mean.”)

Mean

how2/ **ADD** up all of the data and **DIVIDE** by the number of pieces of data.

ex/ find the mean of 11.4, 8, 9.14, and 7

$$\begin{array}{r}
 11.4 \\
 \text{(Add)} \quad 8. \quad \text{(Don't forget to line up the decimals.)} \\
 9.14 \\
 + 7. \\
 \hline
 35.54
 \end{array}$$

$$\begin{array}{r}
 \underline{8.885} \text{ is the mean} \\
 \text{(divide)} \quad 4) 35.54
 \end{array}$$

Median

how2/ Put the data in order and find the **MIDDLE**.
If there are two middle numbers, find the mean of those two.

ex/ The data above, in order: 7, 8, 9.14, 11.4
Since there are two in the middle,
add $8 + 9.14 = 17.14$
then divide by 2: $17.4 \div 2 = 8.57$

Mode

how2/ Find the data that occurs **MOST OFTEN**. There may be more than one, or none at all.
The data above has no mode.

dfsoiej
lkjsde ther tier

<date>

<Notes for day 2>

Pace

def/ noun: ① a single step

② speed of motion

verb: ① walk at a steady speed

② measure distance by counting # of steps

③ move at a particular speed

Personal Pace Ratio

This is a **fraction** we will use to compare the number of steps you take to the distance you walk.

<This is because there are usually 8 beats to a measure in marching songs and a football field is divided by five-yard lines. The marching band could stay organized by hitting the lines at the start of each measure.>

ex/ Marching band members are trained to walk with a ratio of 8 steps to five yards. Each band member's *personal pace ratio* should be $\frac{8 \text{ steps}}{5 \text{ yards}}$ or $\frac{5 \text{ yards}}{8 \text{ steps}}$, which

<Time permitting, this is a good opportunity to discuss the difference between ratios, rates, and unit rates. Also, we will use feet, not yards.>

can be divided to $1.6 \frac{\text{steps}}{\text{yard}}$ or $0.625 \frac{\text{yards}}{\text{step}}$.

<date>

<Notes for day 3>

Convert number of
STEPS to FEET

how2/

MULTIPLY your STEPS by your Personal Pace Ratio

☞ Remember: units must cancel!

ex1/ It takes you 15 steps to pace the length of the room. How long is the room?

(multiply) 15 ~~steps~~ · $\frac{\text{feet}}{\text{step}}$ = ??? feet

ex2/ How far would you walk in 50 steps?

<date>

<Notes for day 4>

Scale

def/ ratio of the size of a map or model to the actual size

ex/ If you draw on $\frac{1}{4}$ " graph paper and let each square represent one square foot, then the scale is $\frac{1}{4}$ in. to 1 ft.

The scale could also be written $\frac{1}{4}$ in. to 12 in., or if you want to get rid of the fractions, multiply each side by 4:

$$\begin{array}{ccc} 4 \cdot \frac{1}{4} \text{ in.} & \text{to} & 4 \cdot 12 \text{ in.} \\ 1 & \text{to} & 48 \end{array}$$

Scale Drawing

how2/

- ① Make a rough sketch on plain paper
- ② Measure each actual length in STEPS and mark them carefully on the sketch
- ③ Also measure the distance things are from the edge of the room or property
- ④ Make a table with these headings: What measured, # of Steps, # of Feet
- ⑤ Convert all steps to feet using your personal pace ratio
- ⑥ Decide on a reasonable scale to fit the drawing on the graph paper
- ⑦ Draw the map on graph paper
- ⑧ Use tools: more graph paper, rulers, protractors, erasers
- ⑨ Title the drawing
- ⑩ Write the scale on the drawing.

was

Things you see on a MAP

<generate list with class>

<date>

<Notes for day 6>

Convert PART to PERCENT

how2/ PART divided by WHOLE, times 100

ex/ 94 out of 125 students have cell phones, so
 $94 \div 125 \cdot 100 = \underline{\hspace{2cm}}$ % of students have cells.

Convert PERCENT to DEGREES

how2/ PERCENT divided by 100, times 360°

ex/ $75.2\% \div 100 \cdot 360^\circ = \underline{\hspace{2cm}}^\circ$
This give the angle of the *sector* in a pie graph.

Pie Graph
(a.k.a. circle graph)

- how2/**
- ① Make sure data includes all parts of a whole
 - ② Make a table with the headings:
category or sector label, part, percent, degrees
 - ③ Fill in the table with the label and the number for each part. Check that the parts add up to the whole.
 - ④ In the table, convert each Part to a Percent.
 - ⑤ Check that the percents add up to about 100.
 - ⑥ Convert each Percent to Degrees.
 - ⑦ Check that the degrees add up to about 360.
 - ⑧ Make a circle and draw the first line from the center of the circle to the edge.
 - ⑨ Use a protractor to measure, and draw each angle.
 - ⑩ Label each sector.

ex/ Complete the table and make a pie graph.

| Sector Label | Part | Percent | Degrees |
|-------------------------------------------------------------------------------------------------------------|------|---------|---------|
| <Survey class to find favorite ice cream flavor, type of music, brand of sneakers, or something like that.> | | | |

Name: _____

Date: _____

Practice 2: Converting Steps to Feet

Write your personal pace ratio here: _____

Use YOUR personal pace ratio for each conversion.

Please SHOW YOUR SET-UP. Remember, UNITS must CANCEL!

- 1) What is the distance you travel in 100 steps?

- 2) What distance will you walk in 42 steps?

- 3) What is the length in feet of a fence that takes you eighty-three steps to pass?

- 4) What is the perimeter of a rectangular garden that is 18 steps long and 13 steps wide?
Please show your set-up.

- 5) I walk 15 feet in 8 steps.

Is my personal pace ratio $\frac{15 \text{ ft.}}{8 \text{ steps}}$ or $\frac{8 \text{ steps}}{15 \text{ ft.}}$? **Are they the same?** Explain your thinking, and convince me you are correct.

.....

.....

.....

.....

.....

.....

.....

Name: _____

Date: _____

Field Activity A: Measuring Pace

In this activity, you will find the length of your step by walking different measured lengths and taking the mean of the number of steps it took you to walk that distance. You will do this on two different days to see if you can keep your pace the same.

Try to walk at a steady speed, with uniform steps.

❶ DATA for the first day out:

| Station | Length in ft. | Number of Steps Taken | | | MEAN | Length / Mean |
|---------|---------------|-----------------------|---------|---------|------------|---------------|
| | | trial 1 | trial 2 | trial 3 | # of steps | |
| A | | | | | | |
| B | | | | | | |
| C | | | | | | |
| | | | | | | |

❷ DATA for the second day:

| Station | Length in ft. | Number of Steps Taken | | | MEAN | Length / Mean |
|---------|---------------|-----------------------|---------|---------|------------|---------------|
| | | trial 1 | trial 2 | trial 3 | # of steps | |
| D | | | | | | |
| E | | | | | | |
| | | | | | | |

❸ DATA for the unknown lengths – this time only do two trials:

| Station | Number of Steps Taken | | MEAN | Length / Mean |
|---------|-----------------------|---------|------------|---------------|
| | trial 1 | trial 2 | # of steps | |
| F | | | | |
| G | | | | |
| H | | | | |

Field Activity A: Measuring Pace, side 2

❹ Find your Personal Pace Ratio >>>Challenge by Choice<<<

I want a challenge!

I can think of two ways to calculate your personal pace ratio:

- A)** Find the total length. Find the total of the Mean # of steps. Get the pace ratio by dividing total length \div total Mean # of steps.
- B)** Find the pace ratio for each station in the last column of the table. To get your personal pace ratio, find the mean of all of these ratios.

Is one way better? Do they come out the same? Is there a different or better way?

Show which way you used to find **your** personal pace ratio.

Tell me what to do!

- A)** Calculate the last column for Stations A, B, C, D, & E by dividing Length \div Mean # of steps. This will give you your average pace ratio for each station.
- B)** Find the mean of your five ratios. Please show your set-up below, even if you use a calculator.

⑤ Write your **PERSONAL PACE RATIO** here (don't forget the units!): _____

⑥ Use your Personal Pace Ratio to calculate the lengths from Stations F, G, and H. Look at your notes if you need to remember how to do this.

Name: _____

Date:

Field Activity B: Scale Drawing of the Schoolyard

1) Sketch the schoolyard below. You must include at least these things:

- the school the garden grassy areas something else arrow
to North

2) Pace the measure of all lines in STEPS and write the number of steps on the sketch.

3) Pace the number of steps BETWEEN things, and write these measurements on the sketch.

Field Activity B: Scale Drawing of the Schoolyard, page 2

- 4) List the measurements in the first two columns of the table.
- 5) Convert STEPS to FEET using your personal pace ratio. Remember, units must cancel.

| What was measured (back left side of school, etc.) | Number of STEPS | Length in FEET |
|----------------------------------------------------|-----------------|----------------|
| | | |

- 6) A piece of 1/4" graph paper is about 32 squares wide by 42 squares long.
If each square represents one foot, then the schoolyard must not be bigger than 32' by 42' to fit on the paper.
If each square represents 10 feet, then the schoolyard can be up to 320' by 420 feet to fit on graph paper.
What scale will you use to fit our schoolyard on the graph paper? one square represents

Or, in other words, 1/4" =

Challenge: convert to a scale with cancelled units:

- 7) After you choose the scale, draw the schoolyard to scale on 1/4" graph paper. Don't forget to use the tools you need: rulers, the edge of graph paper, protractors, erasers.
- 8) Title your drawing.
- 9) Write the scale on your drawing.
- 10) REFLECTION: On a piece of lined paper, write two paragraphs.

In the first paragraph, explain the process you used to make a scale drawing of the schoolyard.

In the second paragraph, describe the decisions you had to make and the problems you had to overcome.

Name: _____

Date: _____

Field Activity C: Analyzing Dudley Square

GROUND RULES

- (1) Each person is responsible for completing their OWN worksheet.
- (2) Groups must STAY TOGETHER.
- (3) Be ON TIME when we meet at _____ at _____ to return to school.
(Time) (Place)

MY GROUPS BLOCK IS _____

Data:

| Describe the Property (name or address or what it looks like) | Number of PACES | Number of FEET |
|--------------------------------------------------------------------------|----------------------------|---------------------------|
| | | |

Name: _____

Date: _____

Assessment: Analyze Your Place

Please identify the block you are going to analyze:

_____ between _____ and _____

Overview

In this assessment, you will use the skills from the past few weeks in order to analyze a block you know well, preferably near where you live. You will

pace the frontage of the block

convert the measurements **to feet**

choose **categories** for the kinds of properties on that block

total the frontage for each category and **convert** the total feet **to percent**

use your data to make a **pie graph**

make a **scale drawing** of the block, labeled with the businesses

write a one-page **reflection** explaining what you learned, what was challenging, and how you would improve the assignment.

present your analysis to the class.

Requirements and Rules

The block you choose must have at least three businesses.

Use your own pacing to measure the block.

Organize your data and calculations neatly in tables.

Show the conversions you make: steps to feet, feet to percent, percent to degrees.

Show the category you chose for each property.

Make the pie chart by hand, not on the computer.

Write the scale you used on your scale drawing.

Turn in all of your data, tables, calculations, your pie chart & drawing, along with THIS SHEET.

| Skills demonstrated | Y | N | Skills demonstrated | Y | N |
|---------------------------------------|---|---|--------------------------|---|---|
| Estimate linear dimensions by pacing. | | | Make a pie graph. | | |
| Organize data in tables. | | | Make a scale drawing. | | |
| Convert units of measure. | | | Reflect on thinking. | | |
| Find percent. | | | Present work to a group. | | |