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Georgia Performance Standards Framework for MATHEMATICS – GRADE 4

Unit 4 Organizer: “PLANE COORDINATES, GEOMETRIC FIGURES, AND GRAPHS”
(6 weeks)

OVERVIEW:

In this unit students will:

- identify and classify angles;
- distinguish between parallel and perpendicular lines and use them in geometric figures;
- identify differences among quadrilaterals;
- locate points in the coordinate plane;
- graph ordered pairs in the first quadrant;
- identify different types of graphs;
- define a graph as either a bar, line, or pictograph;
- compare and Contrast bar, line, and pictograph; and
- show evidence of finding missing data in graphs.

Although the units in this instructional framework emphasize key standards and big ideas at specific times of the year, routine topics such as estimation, mental computation, and basic computation facts should be addressed on an ongoing basis. Ideas related to the five process standards, problem solving, reasoning, connections, communication, and representation, should be addressed constantly as well. The first unit should establish these routines, allowing students to gradually enhance their understanding of the concept of number and to develop computational proficiency.

To assure that this unit is taught with the appropriate emphasis, depth, and rigor, it is important that the tasks listed under “Evidence of Learning” be reviewed early in the planning process. A variety of resources should be utilized to supplement, but not completely replace, the textbook. Textbooks not only provide much needed content information, but excellent learning activities as well. The tasks in these units illustrate the types of learning activities that should be utilized from a variety of sources.
ENDURING UNDERSTANDINGS:

- Shapes are classified by their angles.
- Constructed models are enhanced by the use of a variety of shapes.
- Combining shapes creates advanced geometric figures.
- Cubes and rectangles are classified by the number of planes within the object.
- The analysis and interpretation of data relates to the type of graph used to display the information.
- Graphical representations can be used to make predictions and interpretations about real world situations.

ESSENTIAL QUESTIONS:

- How many geometric figures can I create from combining different quadrilaterals?
- Where do we see parallel and perpendicular lines in everyday life?
- How do I compare and contrast shapes only using their angles?
- Why are geometric figures important?
- How do quadrilaterals relate to cubes and rectangles?
- How do I use ordered pairs?
- When do ordered pairs assist me with reading graphs?
- What is the difference between bar graphs, line graphs, and pictographs?
- How can graphing patterns be used to predict what will happen next?
- How are graphs used in the world around us?
- Can I effectively represent data in graphs?
STANDARDS ADDRESSED IN THIS UNIT

Mathematical standards are interwoven and should be addressed throughout the year in as many different units and activities as possible in order to emphasize the natural connections that exist among mathematical topics.

**KEY STANDARDS:**

**M4G1. Students will define and identify the characteristics of geometric figures through examination and construction.**
   a. Examine and compare angles in order to classify and identify triangles by their angles.
   b. Describe parallel and perpendicular lines in plane geometric figures.
   c. Examine and classify quadrilaterals (including parallelograms, squares, rectangles, trapezoids, and rhombi).
   d. Compare and contrast the relationships among quadrilaterals.

**M4G2. Students will understand fundamental solid figures.**
   a. Compare and contrast a cube and a rectangle prism in terms of the number and shape of their faces, edges, and vertices.
   b. Describe parallel and perpendicular lines and planes in connection with the rectangular prism.
   c. Construct/collect models for solid geometric figures (cube, prisms, cylinder, etc.).

**M4G3. Students will use the coordinate system.**
   a. Understand and apply ordered pairs in the first quadrant of the coordinate system.
   b. Locate a point in the first quadrant in the coordinate plane and name the ordered pair.
   c. Graph ordered pairs in the first quadrant.

**M4D1. Students will gather, organize, and display data according to the situation and compare related features.**
   a. Represent data in bar, line and pictographs.
   b. Investigate the features and tendencies of graphs.
   c. Compare various graphical representations for a given set of data.
   d. Identify missing information and duplications in data.
RELATED STANDARDS:

M4P1. Students will solve problems (using appropriate technology).
   a. Build new mathematical knowledge through problem solving.
   b. Solve problems that arise in mathematics and in other contexts.
   c. Apply and adapt a variety of appropriate strategies to solve problems.
   d. Monitor and reflect on the process of mathematical problem solving.

M4P2. Students will reason and evaluate mathematical arguments.
   a. Recognize reasoning and proof as fundamental aspects of mathematics.
   b. Make and investigate mathematical conjectures.
   c. Develop and evaluate mathematical arguments and proofs.
   d. Select and use various types of reasoning and methods of proof.

M4P3. Students will communicate mathematically.
   a. Organize and consolidate their mathematical thinking through communication.
   b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
   c. Analyze and evaluate the mathematical thinking and strategies of others.
   d. Use the language of mathematics to express mathematical ideas precisely.

M4P4. Students will make connections among mathematical ideas and to other disciplines.
   a. Recognize and use connections among mathematical ideas.
   b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
   c. Recognize and apply mathematics in contexts outside of mathematics.

M4P5. Students will represent mathematics in multiple ways.
   a. Create and use representations to organize, record, and communicate mathematical ideas.
   b. Select, apply, and translate among mathematical representations to solve problems.
   c. Use representations to model and interpret physical, social, and mathematical phenomena.
CONCEPTS/SKILLS TO MAINTAIN:
It is expected that students will have prior knowledge/experience related to the concepts and skills identified below. It may be necessary to pre-assess in order to determine if time needs to be spent on conceptual activities that help students develop a deeper understanding of these ideas.

- Correctly name figures by number of sides and vertices.
- Identify the properties of fundamental geometric figures.
- Identify parallel and perpendicular lines in real world situations.
- Utilize x and y axis in ordered pairs.
- Transfer data from charts to graphs and graphs to charts.
- Understand that graphs are a visual representation of information called data.
- Quickly recognize types of graphs and identifies the name (bar, line, or pictograph).
- Interpret data from graphs.

SELECTED TERMS AND SYMBOLS:
The following terms and symbols are often misunderstood. These concepts are not an inclusive list and should not be taught in isolation. However, due to evidence of frequent difficulty and misunderstanding associated with these concepts, instructors should pay particular attention to them and how their students are able to explain and apply them.

The definitions below are for teacher reference only and are not to be memorized by the students. Teachers should present these concepts to students with models and real life examples. Students should understand the concepts involved and be able to recognize and/or demonstrate them with words, models, pictures, or numbers.

- **Bar graph**: A way of displaying data using horizontal or vertical bars so that the height or length of the bars indicates its value.
- **Chart**: A way to organize data into columns and/or rows.
- **Data**: Information collected about people or things.
- **Edge**: The intersection of a pair of faces in a three-dimensional figure.
Face: One of the polygons that makes up a polyhedron.
Hexagon: A polygon with 6 sides.
Irregular Polygon: A polygon whose interior angles are not congruent and/or its sides are not equal in length.
Line graph: A graph that displays data by using points joined by line segments. These line segments are used to show how data change over a period of time.
Parallel: Two lines are parallel if they lie in the same plane and they do not intersect.
Pentagon: A polygon with 5 sides.
Perpendicular: Two lines are perpendicular if they intersect at a right angle.
Pictograph: A graph in which the data is displayed in a table using pictures and symbols to show and compare information. Also referred to as a picture graph.
Plane figure: A figure of which all points lie in the same plane. (Plane figures included in the Grade 4 GPS are triangle, square, rectangle, trapezoid, quadrilateral, pentagon, hexagon, and irregular polygons.)
Polygon: A closed plane figure (no gaps or openings) formed by three or more line segments.
Polyhedron: A 3-dimensional figure that has polygons as faces.
Quadrilateral: A polygon with 4 sides.
Regular Polygon: A polygon that is equiangular (all angles are congruent) and equilateral (all sides are congruent).
Solid figure: A figure that has length, width, and thickness (i.e., a figure that is 3-dimensional). (Solid figures in the Grade 4 GPS include prisms, cylinders, cones, and spheres.)
Sphere: The set of all points in space that are equidistant from a fixed point, called the center. (Examples of these three-dimensional figures include a basketball or a globe.)
Table: A way to organize data into columns and/or rows.
Trapezoid: A quadrilateral that has only one pair of parallel sides.
Vertex: The common endpoint of two line segments that serve as two sides of a polygon. The point(s) where the edges of a 3D object intersect.

EVIDENCE OF LEARNING:

By the conclusion of this unit, students should be able to demonstrate the following competencies:
The following tasks represent the level of depth, rigor, and complexity expected of all fourth grade students. These tasks or a task of similar depth and rigor should be used to demonstrate evidence of learning.

- Quadrilateral Challenge
- Shape Shifting
- Polygon Challenge
- The Ideal Bedroom
- Lost
- Geometry Map
- “And the survey says………..”
- Having a Graphing Good Time
- Weather Graphs
- Geometry Map

**Culminating Activity:** “Geometry Map”
Students represent and apply their understanding about geometric terms and figures while constructing a map of a city following specific guidelines.
STRATEGIES FOR TEACHING AND LEARNING:

- Students should be actively engaged by developing their own understanding.
- Mathematics should be represented in as many ways as possible by using graphs, tables, pictures, symbols and words.
- Appropriate manipulatives and technology should be used to enhance student learning.
- Students should be given opportunities to revise their work based on teacher feedback, peer feedback, and metacognition which includes self-assessment and reflection.

Classroom Routines

The importance of continuing the established classroom routines cannot be overstated. Daily routines must include such obvious activities such as graphing class achievements, noticing parallel and perpendicular lines in the school, finding quadrilaterals and other plane figures, and interpreting data from various graphs posted in school. They should also include less obvious routines, such as how to work cooperatively, how to use materials in a productive manner, how to put materials away. An additional routine is to allow plenty of time for children to explore new materials before attempting any directed activity with these new materials. The regular use of the routines is important to the development of students’ understanding of expectations which will support students’ performances on the tasks in this unit. See unit 1 for suggestions concerning specific ideas for classroom routines.

TASKS:

The collection of the following tasks represents the level of depth, rigor and complexity expected of all fourth grade students to demonstrate evidence of learning.
Quadrilateral Challenge

Quadrilateral Challenge

Part 1:
1. Name each point that is shown on your circle with a capital letter.
2. Using the points that you labeled, draw as many different quadrilaterals as possible within the circle.
3. Each quadrilateral should be drawn using a different colored pencil or crayon.
4. Points may be used for more than one quadrilateral.
5. Be prepared to share some of the quadrilaterals you were able to create.

Part 2:
6. On a second copy of the circle, name each of the points that are shown with a capital letter.
7. Create the following shapes on your circle by connecting points. Each 2-D shape should be drawn in a different color. Can you create them all?
   a. square
   b. trapezoid
   c. parallelogram
   d. rhombi
   e. rectangle
Quadrilateral Challenge

Discussion, Suggestions, Possible Solutions

Give each child a copy of the circle shown below. Ask students to label each point on the circle with a capital letter. Explain to children that they are going to create quadrilaterals by connecting points. Each quadrilateral should be completed in a different color to make it easier to locate them on the circle.

The teacher may want to ask the students, “How many points will be used for each quadrilateral and why?” prior to starting the task.

The purpose of this task is to have students become familiar with shapes, primarily quadrilaterals. Students have an opportunity to create a minimum of 20 quadrilaterals when performing this task. Once students have created their quadrilaterals and can show how to find them, they may get another copy of the circle. Now they will need to use their circle to create other 2-D shapes. Have children create a key on their circle page to represent each of the shapes that they were able to find.

Some sample questions to ask students may include:

1. How many quadrilaterals were you able to find?
2. What type of pattern or process did you use to help create your quadrilaterals?
3. What other shapes were you able to create?
4. Is there a type of shape that was easier/harder to create than others? Why?

Extension:

- Have children name and list each quadrilateral that they were able to find. Ex. Quadrilateral ABCD because points ABCD are the points that this shape includes as its vertices.
- Have students try to create different familiar shapes within the circle. Students should classify the shapes that they form.
- Allow children the opportunity to plot more points on their circle and try to come up with different shapes.
Shape Shifting

Create each of the following shapes by folding a piece of paper. Draw and label each shape you made in your math journal.

- a. Equilateral triangle
- b. Right triangle
- c. Acute triangle
- d. Obtuse triangle
- e. Square
- f. Rectangle
- g. Rhombus
- h. Trapezoid
- i. Parallelogram
- j. A quadrilateral that is different from any of the above shapes.

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Shape Shifting

Discussion, Suggestions, Possible Solutions

This task leads students to apply various folding strategies in order to create various triangles and quadrilaterals. They use the kinesthetic modality to fold the paper into actual shapes then transfer learning to visual/spatial modality by drawing representations of the models they create. For some children paper folding can be a little challenging at first. Reassure children that it is okay to make mistakes when folding and to persevere until they are successful. It will be necessary to have several extra pieces of paper available for all students. This task helps students to become more confident in their spatial abilities and the recognition of shapes within shapes.
Extension:

After students have folded paper into different shapes and angles, challenge students to write directions for the shape/angle that they chose so that someone else could follow their directions and create the same shape/angle. Allow students to try these directions with a partner or small group to see how successful they were at describing their paper folding steps.

• Polygon Challenge
Polygon Challenge

You have been given the task of building at least two different polygons using pattern blocks. There are specific guidelines you must follow.

Part One:
Select the appropriate blocks for beginning your challenge. Here are the requirements for your building materials.

- Use a total of 8 blocks.
- You may only use trapezoids, triangles, hexagons, and rhombi pattern blocks for this activity.
- List the number of each shape and color that was used to build your polygon.
- Draw and color your polygon on graph paper.
- Label your polygon with the correct name.

Part Two:
Design a second polygon that is different from the first one that you built.

- List the number of each shape and color that was used to build your polygon.
- Draw and color your polygon on graph paper.
- Label your polygon with the correct name.

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Polygon Challenge

Discussion, Suggestions, Possible Solutions

*Students should be able to identify basic, regular polygons with ease prior to this task. The simplest polygons to create with this activity are irregular – varying in the size of their sides and angles. Encourage students to strive toward making regular polygons (quadrilaterals, pentagons, hexagons, octagons) for which they know the name. Teachers should facilitate the process by monitoring students closely as they work.*
Manipulative pattern blocks are encouraged as materials in order to allow kinesthetic learners to process their environment and scaffold their learning. However, another great way for students to participate in this task is through the use of a website such as http://www.arcytech.org/java/patterns/patterns_j.shtml that allows students to “move” pattern blocks around on the page. Below are examples of creations that have been built according to the requirements of the task:

Parallelogram

Hexagon

Encourage the students to share their solutions and to describe their problem solving strategies. Students should recognize that many solutions have the same number of each type of pattern blocks arranged in different ways.

Extension:

Have students create a pictograph or a bar graph to demonstrate the number and type of pattern blocks they used for their design. This would emphasize that the solution can be right and not necessarily look the same.
The Ideal Bedroom

You are the president of “Ideal Bedroom” company. Your job is to design bedrooms for famous people throughout the world. It so happens that your favorite famous person has contacted you to create an “Ideal Bedroom” for them. First you will draw a small version or rough draft of the bedroom you want to create. After you are sure that is the design you wish to make, draw an impressive larger version on a piece of graph poster paper to share with your client so that he/she can agree to pay you the huge salary that you deserve for being so creative.

- Name your famous client.
- Using your graph paper draw a unique bedroom that will fit their personality and life style.
- On a separate sheet of paper list every shape that you used.
- Each square on your graph paper is equal to one foot by one foot.

Discussion, Suggestions, Possible Solutions

This task could be completed without meticulous instructions, or it could be more detailed if the teacher wants to require a certain number of rectangles, squares, circles, and etc. to be used in the design of the bedroom. The teacher could also require things like closet doors, doors to the outside of the room, and windows. This would vary depending on the group of students participating.
As an extension, it is recommended that students create the entire bedroom with no adult influence or suggestions. Then, if the student struggles with what to include in the bedroom, the teacher could give direction and lead the student to think about what kinds of shapes beds, tables, desks, shelves, chairs, windows, and doors can be used.

This type of discussion should encourage a learner who is struggling with the task to begin to see possibilities for their “design”. After the teacher or selected person “approves” the design of the room, the students will make their room on a much larger scale – poster size. Poster paper with grid lines is recommended but not required. Having various colors of paper and markers available will make this activity more engaging for students.

• Lost

Lost

You are at an amusement park with your friends. It is time to meet back at the entrance and you have to follow the directions from your teacher so you will not be left. You are currently at the roller coaster which is located at ordered pair (14, 20). Listen to your teacher as she/he gives the coordinates you need to follow to get back to the entrance.

• Label the given points on the graph with the correct ordered pairs.
• Paste the pictures near the appropriate and correctly labeled points.
Discussion, Suggestions, Possible Solutions

Students should have a copy of a blank coordinate plane similar to the one shown below.

Amusement Park
As the teacher reads the directions orally, the students should follow along on the graph, make notes concerning the directions, and label the points mentioned with the ordered pairs. They should then cut out and paste the appropriate pictures near the labeled points.

**Teacher reads:**

*Walk to the Ferris Wheel at (4, 17), next find the log shoot at (14, 13), travel southwest to the tilt-a-whirl at (4, 9), head due south to the bumper cars at (4, 4), head northeast to the concession stand at (11, 7), then walk southeast to (20, 5) and meet us there to leave.*

A copy of suggested pictures for the students to use during the cut and paste portion of the task is shown below.

- Roller Coaster
- Ferris Wheel
- Log Shoot
- Tilt-a-Whirl

- Bumper Cars
- Concession Stand
- Meeting Place
The solution is shown below.

Amusement Park

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Extension

- Allow students to create points on a map to give another student to find and label.
- Have students come up with the points instead of giving them.
- Plot a rectangle at x, y and determine the vertices.

• And the Survey Says…

And the Survey Says…

You are putting together a news report for your local T.V. station. This report will show what 4th grade students from your school think about the lunch choices in the cafeteria.

1. List the 5 most common entrees served in your school cafeteria.
2. Design a survey with your class/group to distribute to all the 4th graders in your school. The survey should ask students to select their favorite from the list of five lunchroom entrees.
3. Compile the data from the survey by counting the votes for each entree.
4. Draw your graphs and include the data you collected. Make sure it is neat and easy to read.
5. Share, explain, and display your work in the form of a television news report.
6. Develop a “test” for those who view the data. (Each group member should write one question about the data for the “test”.)

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And the Survey Says…

Discussion, Suggestions, Possible Solutions

This task could possibly take more than one day. The first day would be for planning the survey and the details for data collecting. The first two steps of the task may or may not be done in a whole group setting with the teacher as a facilitator. If it is done in a whole group setting, the class could decide upon a deadline for the surveys to be completed and returned, a place for the surveys to be returned, select class representatives to deliver the surveys to the other teachers and ask for their class to participate in the survey. Be sure that these representatives can accurately explain the surveys, the deadline, and the designated return area. This would also be a good time for the class to develop a rubric for the remaining steps of the task.

The second day is for compiling and displaying the data into graphs. Make sure that students understand their role and have an assessment system in place for evaluating their performance in the cooperative group setting. Guidelines, such as a rubric, should be discussed and in place for the evaluation of the final graph or chart that each student makes. A suggestion could be to have each student be responsible for a different piece of the task such as 1) Chart maker, 2) Line graph maker, 3) Bar graph maker, 4) Pictograph maker. It is necessary to assess 2 areas – cooperative group performance and performance of the graphing task. If the students are not familiar with how to work cooperatively; it would be wise to have a class discussion to determine protocols for group work which may include being willing to accept recommendations for improvement from their peers; being a polite and courteous group member who only shares comments that are helpful – not hurtful; take turns so that everyone in the group has a chance to share their work and comment on the work of others, etc.

• Have a Graphing Good Time
Have a Graphing Good Time

1. Answer the following questions about the circle graph shown to the right.
   a) Which sport is the most favorite of Mrs. Smith’s students?
   b) Which sport is the least favorite of Mrs. Smith’s students?
   c) Which 2 sports are almost the same in the number of students who favor them?

2. Use the circle graph to convert the data into the graphs listed below. Make sure all data is represented on your graphs. To make your graphs more presentable, use lots of color and organization.
   a) pictograph
   b) line graph
   c) bar graph

Have a Graphing Good Time

Discussion, Suggestions, Possible Solutions

Encourage creativity from the students as long as they are mathematically correct. Allow students to share their graphs and discuss how the graphs are similar or different from one another.
Some suggested questions:

How can you show relationships between graphs?
Which graph(s) represent the data most effectively? What makes it most effective?
Which graph is the easiest for you to read?
What makes graphs easier or harder to read?

• Weather Graphs
Weather Graphs

1. Answer the following questions about the graph shown to the right.
   a.) Which summer month had the highest average temperature?
   b.) What was the average temperature in June?
   c.) What was the difference of the average temperature between June and July?

2. Use the following clues to create a bar graph that represents the average temperatures for last year.
   a.) The average temperature in June this year was two degrees cooler than it was last year.
   b.) The average temperature in July last year was nine degrees warmer than June of the same year.
   c.) Due to a cold front that brought temperatures to a record low, August of last year was five degrees cooler than the month before and seven degrees cooler than it was one year later.

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Weather Graphs

Discussion, Suggestions, Possible Solutions

The first section of this activity is simple data interpretation. Students either have their own graph to view, or the teacher shares a large copy on the overhead, on a poster, or with a projector or “active” board. The teacher leads a discussion and the questions are answered individually by students in a journal or on a note-taking sheet. It is recommended that answers are discussed after students have ample time to record their own thoughts to each of the questions for part one.

Part 2 involves higher order thinking skills on the part of each student. Learners need to follow the directions closely to create a new bar graph that represents the data provided in section 2 above. Materials that need to be available include crayons, colored pencils, or markers, as well as paper on which to draw the graphs. Also have rulers available and encourage incorporating math tools to create neat work and straight lines. A computer program such as “The Graph Club” would provide an alternative to making the graphs with consumable materials. If you choose to make the graphs from scratch the “old fashioned” paper and pencil way, it could take some students up to 60 minutes to finish while it takes others 10 minutes. Keep this in mind and consider using a rubric for evaluating the graphs. If you use a rubric, allow the students to take ownership in the creation of the rubric. Have them determine what will be considered quality work before beginning the process of making the graphs. Also, consider having peer evaluations of work prior to turning the graph in for a final teacher evaluation.
**Culminating Task**

This culminating task represents the level of depth, rigor, and complexity expected of all fourth grade students to demonstrate evidence of learning.

### Unit 4 Task: “GEOMETRY MAP”

You are given the task of developing a city on the planet Mars. The only things that you have to have in your city are the following:

- 4 streets that are parallel to each other
- 1 highway that is perpendicular to the 4 parallel streets
- 1 avenue that intersects at least 2 streets but is not perpendicular to them
- 3 rectangular buildings
- 4 square buildings
- 1 trapezoid building
- 1 park with a circular swimming pool
- 1 triangular sandbox in the park
- 2 rectangular basketball courts in the park
- The city must have a name
- All parts must be labeled with original names
- Identify the coordinates of at least 4 different places on your map
- **BONUS:** make two of your buildings in their 3-D form, or write directions on how you could make them 3-D.

After you are sure you have all these parts included on your map, go back and add details to your city. You may want to add color or extra buildings to your map, just as long as you have all of the requirements listed above.
### Suggestions for Classroom Use

- Peer Review
- Display for parent night
- Place in portfolio
- Photographs

### Discussion, Suggestions and Possible Solutions

*Students have worked with shapes in previous grades. They should have prior knowledge of the shapes before they begin. A review of vocabulary would be an effective way of leading into this culminating activity. One of the most important aspects of this task is for the children to demonstrate the mastery of the meaning of each term and show how to use and recognize these terms in their everyday lives. Creativity should be stressed and encouraged. Allow children to share their final products with their classmates.*

*It would be helpful for students to create a grid or coordinate system (1st quadrant only) on their map before beginning their design. The lines could be drawn in very light pencil so as not to distract from the final product. Graphing chart paper is excellent to use if it is available.*

*Adaptations:*

*Some students may need extra time getting started on this activity because it requires planning and cooperation. This activity does take a considerable amount of time to complete, therefore, teachers should allow time for students to talk and discuss their project as they work through the directions and creation. For more challenged students teachers could cut out shapes for them ahead of time and then allow the students to add to the map. Teachers could also assist in brainstorming names for their map. For students that need more of a challenge, they could add a new part to the city and make their own rules for things to add to the map. Students could have a housing complex or university they could design. Each group could have a different place to design and make the rules that other groups have to follow.*