Imagine, Design, and Build a City with this 2D & 3D Adventure!

GEOMETROCITY
BUILDING A CITY WITH MATH

- Project Based Learning
- Real World Application
- Geometry, Maps, & More
- Extension Activities
- Differentiate Levels

CCSS aligned

SALE
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About this Project

Geometrocity is a project based learning activity where students will take their geometry skills and design their own city. This multi-tiered activity allows for immediate differentiation because of its size, and students may complete parts or the entire project based on your choosing. This project doesn’t just focus on math skills, as there are components of social studies (mapping skills), writing, problem solving and comprehension skills too.

Students will be creating a city that uses 2D and 3D, practicing both plane and solid geometry. Students will utilize many types of geometric skills such as building nets to create buildings and structures along with designing parts of a city with shapes, lines, angles, and more.

Geometrocity is broken into SEVEN phases. Those phases are:

Phase One: Permits
- Reviewing and previewing geometric terms and visuals. Creating a mini-map.

Phase Two: Design & Build
- Up to nine city sections can be built. Each page has 10-14 requirements that must be completed.

Phase Three: Construction
- Putting our city together for the world to see.

Phase Four: Building Up
- Using nets and 3D to make the city rise above the paper.

Phase Five: Assessment
- Three types of self-assessments for students. Self, Individual, and group work.

Phase Six: Tourism
- Create a postcard to persuade visitors to come.

Phase Seven: Challenge
- 5 extra higher level challenges for students that want to create more.

This project aims to focus on geometry, but there are so many other elements of learning present which include problem-solving, making inferences, collaboration, communication, independent learning, and more.

Tips & Ideas:
- This project can be done individually or within a group. It is up to teacher discretion. Teachers can assign this for individuals or as a group project with each participant taking sections and they work together to build a city.
- In my classroom, I will project files like this on our whiteboards so that students and teachers can discuss the instructions and objectives.
- Included at the beginning of this file are some pages filled with different types of maps. Use these as an opportunity to show the differences.
- I’ve included a set of images giving examples of different phases of the project.
- As students begin to construct their city they may want to add cardboard underneath their paper for increased stability.

MATH Common Core Standards
- CCSS.MATH.CONTENT.3.G.A.1
- CCSS.MATH.CONTENT.3.G.A.2
- CCSS.MATH.CONTENT.4.G.A.1
- CCSS.MATH.CONTENT.4.G.A.2
- CCSS.MATH.CONTENT.4.G.A.3
- CCSS.MATH.CONTENT.5.G.B.3
- CCSS.MATH.CONTENT.5.G.B.4
- CCSS.MATH.CONTENT.6.G.A.4
GEOMETROCITY: A City Made of Math

During the design phase, students will create the city on sections that look like this.

As long as users follow the checklist on the right side of the page they may design it however they would like.

Labeling, coloring, and details are extremely important. The more you have the better your city will look.

Try and use as many geometry elements as you build each section.
These finished sections of PHASE TWO have been cut out. Notice how they can match up anyway because the roads match up.

It is important to always have roads at each point. That way you can move your city around or you can match it up with a classmates.
Here’s a look at some of the finished nets that have turned the city into a 3D city from PHASE THREE: Building Up.

There are multiple net sizes to choose from that are small to large. Don’t forget that they can be added to another one too.
GEOMETROCITY: A City Made of Math

PHASE SEVEN: CHALLENGE

Raised Railway

Skyscraper

Highway
Mapping Skills

Over the next four pages, you will see different types of maps. One was created a long time ago, while the others were made more recently. Look closely and discuss with your classmates and teacher some of the differences and similarities between them.

Use these questions to drive the discussion:

• How is each map different from the others?
• How is each map the same as all the others?
• What is each map focusing on? How do you know?
• Which is more appealing to you? Why?
• What kinds of patterns do you see?

There are also a handful of websites for students to use to improve mapping skills:

• Social studies maps: http://classroom.jc-schools.net/basic/ssmaps.html
• National Geographic: http://education.nationalgeographic.com/education/mapping/\?ar=a=6
• World maps: http://www.yourchildlearns.com/map-
GEOMETROCITY: A City Made of Math

The objective of this project is to create a city from scratch by using learned geometry skills and concepts such as:

- Plane Geometry
- Solid Geometry
- Polygon
- Angles
- Symbols
- Coordinates
- Area & Perimeter
- 2D Shapes
- 3D Shapes
- Transformations
- And More

**This project can be completed independently or as a group (your teacher will make that decision).**

You are encouraged to be CREATIVE and use your IMAGINATION with this city. Use your classmates, the Internet, and other resources to make sound decisions. Look at maps, pictures, videos, and collaborate with others to build your ideal city.

As you move through this project there will be certain requirements that must be met, too, but they will be stated clearly for you to see.

Many of the math concepts are used daily in real-world situations such as architecture and design. It is important you recognize the real-world applications of lessons learned in school.

You’ll be demonstrating your skills within geometry to create a city made of math, Geometrocity.
To: (your name here)  
From: City Council of Geometrocity

Congratulations! You have been chosen to design a new city for us. There were thousands of applicants, but we chose you! We think that your knowledge and skills are just what is needed to create this new city.

Your job is to create a city filled with math concepts: geometry, to be more specific. Many people don’t know this but all cities, towns, and buildings are created with math skills as a foundation. This city will be no different and it will be important for you to showcase your geometrical skills to make this a successful place.

You are the architect. You will determine whether this city succeeds or becomes bogged down in city politics and never develops. As lead architect, you will be tasked with creating city infrastructure such as buildings, roads, parks, and more. Along the way, you will have specific design elements that must be incorporated with each portion of the city.

This entire project can be completed individually or you may work with a team. The city council feels comfortable that you’ll make the correct decision.

We look forward to seeing your work.

Sincerely,
City Council
This project will be broken up into THREE phases.

**PERMITS, DESIGN, & CONSTRUCTION**

You will need to work through the phases in the order they appear so that you may finish the project correctly. Failure to do so will result in the termination of your contract to build Geometrocity.

**PHASE ONE: PERMITS**
Mr. Mayor and the City Commissioner have a set of tasks for you to complete to prove you understand geometry enough to build their city. If you pass you’ll get the permits to begin building.
Let's hope you know your geometry.

**PHASE TWO: DESIGN & BUILD**
You and your team begin to build the city. There are nine different sections of the city. In each section there are rules and requirements you must follow. Before you begin working on Phase Two you will read a tutorial to assist you.

**PHASE THREE: CONSTRUCTION**
It’s time to put your city together.
Cutting, gluing, and assembling is your job.
*All the sections from PHASE TWO will begin and merge together and a city will rise.*
Mr. Mayor is all about the politics, so you’re not done yet. Now he wants you to define the geometry terms listed below and draw a picture of each one.

<table>
<thead>
<tr>
<th>Square</th>
<th>Vertex</th>
<th>Line</th>
<th>Hexagon</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Definition</th>
<th>Draw</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Polygon</th>
<th>Quadrilateral</th>
<th>Area</th>
<th>Perimeter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Definition</th>
<th>Draw</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Mr. Mayor is all about the politics, so you’re not done yet. Now he wants you to define the geometry terms listed below and draw a picture of each one.

<table>
<thead>
<tr>
<th>term</th>
<th>definition</th>
<th>draw</th>
</tr>
</thead>
<tbody>
<tr>
<td>line segment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ray</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pentagon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>angle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>acute</td>
<td></td>
<td></td>
</tr>
<tr>
<td>obtuse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>parallel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rectangle</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PHASE TWO: DESIGN & BUILD

On the next few pages you'll build your city using these sections:

- Downtown
- Suburbs
- City Hall
- Industrial Park
- Public Works
- Business District
- City Living
- Entertainment
- Park District

Each section looks like this at the beginning.

You get to make it look like this.

Your job is to fill this section using the listed requirements and your creativity to build Geometrocity.
PHASE TWO: DESIGN & BUILD

CHECKLIST

Over the next few pages on the right side of the paper will be a checklist. You must include all of these elements into each of the sections.

You’ll notice that the first 7-9 items are geometry and the last few are areas within a city. You may combine some of these elements together if you want.

Check off each one when you complete it to help you stay organized.

You are encouraged to add many more elements to each section to create a thriving city.

LABELING

You should label your geometry answers as best as possible through highlighting with markers, colored pencils, pens, or crayons.

Try and make the geometry pop out, but also blend in at the same time. This can be a difficult skill, but with practice you’ll accomplish it.

DO TRY and label buildings, roads, parks, and other aspects of the city.

You will have to write neat and small. TAKE YOUR TIME! Make it take just as long as real road construction.

GOOD LUCK!
Each section has four black bars on each side. Look at the images below for reference.

**You MUST have roads coming in and out at each black bar per section. You may add more roads in each inside each section.

The roads must begin and exit on those spots so you may piece it together when you are all finished.

See how all the roads can connect below.
PHASE TWO: DESIGN & BUILD
Use this list of places to assist you in building your city.

apartment  house  condo  street
block  road  highway  intersection
duplex  bungalow  terrace  garage
cathedral  church  temple  office
store  pharmacy  restaurant  fast food
diner  station  police station  first station
skyscraper  tower  building  town hall
library  museum  theater  bakery
coffee shop  mall  shopping center  drive-in
dry cleaners  laundromat  department store  county building
courthouse  nursing home  hospital  jail
prison  park  gas station  bowling alley
school  daycare  airport  bank
barber shop  book store  beach  snack shop
gym  arena  stadium  concert venue
college  salon  toy store  arcade
Include these elements in your design of downtown.

- 2 Squares
- Pentagon
- 4 Points
- Rectangle
- Right Triangle
- Ellipse
- Obtuse Angle
- Parallel Lines
- Rotation
- Parking Garage
- Skyscraper
- Hotel
- Restaurant
Include these elements in your design of the suburbs.

<table>
<thead>
<tr>
<th>4 Rectangles</th>
<th>5 Squares</th>
<th>Scalene Triangle</th>
<th>Line Segment</th>
<th>Rhombus</th>
<th>Trapezoid</th>
<th>Intersecting Lines</th>
<th>Obtuse Angle</th>
<th>Church</th>
<th>School</th>
<th>Gas Station</th>
<th>Pharmacy</th>
<th>Park</th>
</tr>
</thead>
</table>
GEOMETROCITY

CITY HALL
Include these elements in your design of city hall.

- Square inside a circle
- Line segment
- Arc
- Octagon
- Isosceles triangle
- 3 rectangles touching each other
- Intersecting lines
- Vertex
- Court house
- Attorney's office
- Parking lot
- Subway entrance
- Library

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Include these elements in your design of the industrial park.

- Acute Angle
- Three Parallel Lines
- Circle
- Pentagon
- Scalene Triangle
- Polygon cut with Symmetry
- Decagon
- Parallelogram
- Warehouse
- Gated Empty Lot
- Recycling Depot
- Manufacturing Plant
- Subway Entrance
Include these elements in your design of the public works:

- Three triangles
- Line of symmetry through a polygon
- Pentagon touching a rectangle
- 2 equilateral triangles
- Octagon
- Intersecting lines
- Obtuse angle
- Police station
- Fire house
- City water
- Train station
- Sewage treatment facility
- Post office

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Include these elements in your design of the business district:

- Line of Symmetry
- Scalene Triangle
- Straight Angle
- 2 Rectangles showing a reflection
- 2 Squares
- 3 Triangles all connected
- Ellipse
- Bank
- Hotel
- 5 Taxis
- Pawn Shop
- Office Building
- Coffee Shop
Include these elements in your design of the park district.

- Rhombus
- Arc
- Circle
- Acute Angle
- Hexagon
- Perpendicular Lines
- Isosceles Triangle
- Vertex
- Baseball Field
- Park
- Forest Preserve
- Park
- Pond
GEOMETROCITY

<table>
<thead>
<tr>
<th>CITY LIVING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Include these elements in your design of city living.</td>
</tr>
</tbody>
</table>

| TRAPEZOID | |
| LINE INTERSECTING TWO PARALLEL LINES | |
| HALF-CIRCLE | |
| STRAIGHT ANGLE | |
| POLYGON | |
| 4 POINTS | |
| TWO RAYS WITH THE SAME ENDPOINT | |
| LINE SEGMENT | |
| 3 APARTMENT BUILDING | |
| LAUNDRY MAT | |
| DOG PARK | |
| GROCERY STORE | |
| FAST FOOD EATERY | |

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TOURIST ATTRACTION

Include these elements in your design of tourist attractions.

- CIRCLE INSIDE A SQUARE
- SQUARE CUT INTO FOUR EQUAL PARTS
- ARC
- ACUTE ANGLE
- RADIUS
- 10 VERTICES
- ASYMMETRICAL SHAPE
- SEPTAGON
- MUSEUM
- OPERA HOUSE
- SPORTS ARENA
- ZOO
- AQUARIUM
Include these elements in your design of the entertainment.

- Line with 3 segments
- Irregular polygon
- Intersect
- Kite
- Nonagon
- Complimentary angle
- Reflection of 2 rhombus
- Tangent
- Movie theater
- Museum
- 3 restaurants
- 3 ATM machines
- Dance hall

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Phase Two is complete. Great work—but you’re not finished. It’s time for Phase Three, the construction of Geometrocity!

You will cut out the sections of the city and piece them all together. The number of sections you have depends on how much you’ve finished. On the next page, there is a tutorial for your construction.
PHASE THREE: CONSTRUCTION

Take each section from Phase Two and cut them out.

GO SLOW when cutting!

When all the sections are cut out, lay them down and begin to visualize how you would like your city to look.

If you cut out nine sections it would look something like this.

REMEMBER: Add color to all the city sections. It adds details and looks great.

Go to the next page after you cut and laid out all your pieces.
PHASE THREE: CONSTRUCTION

CITY PLANNING LAYOUT

Did you notice how all the roads match up with each other? You can move all the sections around AND they will always match up. Even if you rotate the sections, everything still fits together.

Planning your layout requires time and thought. Builders can't just put something anywhere they want. There needs to be reasons why they chose it this way.

After you decide the layout of the city explain your reasons to the mayor and commissioner in the space below and/or on the following page.

CITY PLANNING REASONING

________________________

________________________

________________________

________________________

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PHASE FIVE: ASSESSMENT

SELF ASSESSMENT

Now that you've finished Geometrocity, let's assess how well you think you did with the project. Answer each question by circling the numbers that fit best.

<table>
<thead>
<tr>
<th>I know the geometry terms.</th>
<th>every single one</th>
<th>most of them</th>
<th>needed help with a couple</th>
<th>more practice needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was able to follow the directions.</td>
<td>all the time</td>
<td>most of the time</td>
<td>asked a friend</td>
<td>asked the teacher</td>
</tr>
<tr>
<td>Geometry is</td>
<td>great</td>
<td>good</td>
<td>okay</td>
<td>boring</td>
</tr>
<tr>
<td>What was the most difficult part of this project?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I included many details in my work</td>
<td></td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>I did my best work.</td>
<td>excellent</td>
<td>good</td>
<td>fair</td>
<td>needs improvement</td>
</tr>
<tr>
<td>All my work is legible and neat</td>
<td>excellent</td>
<td>good</td>
<td>fair</td>
<td>needs improvement</td>
</tr>
<tr>
<td>My ideas were</td>
<td>awesome</td>
<td>good</td>
<td>average</td>
<td>I could do better</td>
</tr>
<tr>
<td>If I could add more to this project it would be to...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PHASE FIVE: ASSESSMENT

SELF ASSESSMENT: INDEPENDENT WORK
Circle an answer for each statement below.

During this project I...

<table>
<thead>
<tr>
<th>Statement</th>
<th>Needs Improvement</th>
<th>Fair</th>
<th>Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>...worked hard</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...focused when I needed to</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...felt confident in my abilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...stayed on task</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...communicated with teachers and students appropriately</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...was a complex thinker</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...used resources to help me</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PHASE FIVE: ASSESSMENT

SELF ASSESSMENT: GROUP WORK
Circle an answer for each statement below.

During this project I...

<table>
<thead>
<tr>
<th></th>
<th>needs improvement</th>
<th>fair</th>
<th>good</th>
<th>excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>communicated with my team</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>collaborated with my team</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>demonstrated respect to all teammates.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>solved complex problems with my teammates.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>shared responsibilities with my team.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>celebrated great ideas with my team!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>stayed focused and on task with my team.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOMETROCITY

DOWNTOWN

Include these elements in your design.

OFFICE
BANK
PARKING GARAGE
SKYSCRAPER
HOTEL
RESTAURANT
Include these elements in your design.

- Shopping Center
- Grocery Store
- School
- Gas Station
- Neighborhood
- Park
GEOMETROCITY

CITY HALL
Include these elements in your design.

JAIL
COURT HOUSE
ATTORNEY'S OFFICE
PARKING LOT
SUBWAY ENTRANCE
LIBRARY
INDUSTRIAL PARK
Include these elements in your design.
GEOMETROCITY

PUBLIC WORKS
Include these elements in your design.

POLICE STATION
FIRE HOUSE
CITY WATER
TRAIN STATION
SEWAGE TREATMENT FACILITY
POST OFFICE

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### BUSINESS DISTRICT
Include these elements in your design.

- Bank
- Hotel
- 5 Taxis
- Pawn Shop
- Office Building
- Coffee Shop
Include these elements in your design.
CITY LIVING
Include these elements in your design.

BEAUTY SHOP
3 APARTMENT BUILDING
LAUNDRY MAT
DOG PARK
GROCERY STORE
FAST FOOD EATERY

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TOURIST ATTRACTION
Include these elements in your design.

- MUSEUM
- OPERA HOUSE
- SPORTS ARENA
- ZOO
- AQUARIUM
GEOMETROCITY

<table>
<thead>
<tr>
<th>MOVIE THEATER</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUSEUM</td>
</tr>
<tr>
<td>3 RESTAURANTS</td>
</tr>
<tr>
<td>3 ATM MACHINES</td>
</tr>
<tr>
<td>DANCE HALL</td>
</tr>
</tbody>
</table>
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