# Midtown Summer Program

7th Grade Math Curriculum

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## General Information

### Daily schedule

- 5 minutes of warm up problems
- 10 minutes of lecture
- 15 minutes of group work

### Classroom expectations

- Listen when others speak
- Ask questions when they arise
- Respect and encourage your classmates
- Welcome new problem solving approaches
- Defend your solutions with words and pictures and examples

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## Syllabus

### Week 1 — number sense

**Day 1.1**
- Class information
- Information about me as the teacher
- Information will all be online: http://hernandezjose.github.io/midtown/
- Comparisons of fractions, decimals, and percentages
    - Example: please order 0.7, 5/7, 6/5, 1.3, 5/13, ... from lowest to highest

**Day 1.2**
- Introduction Growth mindset
- Math story: the cryptic nature of prices

- Multiplying and dividing integers with fractions

**Day 1.3**
- Multiplying and dividing fractions with fractions (continued...)
- Multiplying and dividing decimals with decimals

**Day 1.4**
- Multiplying percentages greater than and less than one
- Calculating tax, tip, and interest
- Fun break: play krypto (https://en.wikipedia.org/wiki/Krypto_(game))

**Day 1.5 — No class (field trip)**

## Week 2 — rates and proportions

**Day 2.1**
- Review operations with rational numbers
- Math story: pricing employees, break even points in purchases
- Ratio relationships

**Day 2.2 — No class (holiday)**

**Day 2.3**
- Identifying rates from word problems
  - Example: if we can print 13 newspapers in 5 hours, we can print ?? newspapers/hour
- Translating rates to productivity ratios
  - Example: if Jose can bake 2 cakes in 3 hours and Nishith can bake 5 cakes in 3 hours, what is the ratio between Jose's productivity and Nishith's productivity?

**Day 2.4**
- Estimating using productivity rates
  - Example: if Jose bakes 3 cakes in 5 hours, how many full cakes can Jose bake in 13 hours?
- Combinations of productivity rates
  - Example: if Jose bakes 2 cakes/hour and Nishith bakes 3 cakes/hour, then, as a team, Jose and Nishith bake ?? cakes/hour

**Day 2.5**
- Combinations of productivity rates

- Example: if Jose bakes 2 cakes/hour and Nishith bakes 3 cakes/hour and Barak bakes 5 cakes/hour, then, as a team, Jose and Nishith and Barak bake ?? cakes/hour
- Estimating using combined productivity rates
  - Example: if Jose bakes 2 cakes/hour and Nishith bakes 3 cakes/hour, how many cakes can they bake in a bake off that lasts 3 hours? How long does it take them to bake 11 cakes?
- Fun break: how to bid in an auction using game theory principles

## Week 3 — statistical thinking and rates / proportions

**Day 3.1**
- Review productivity rates
- Math story: how Facebook and Google classify you
- Estimating populations based on sampling information
  - Example: Suppose we tag 100 buffalo and then release them back into the wild. If we fly a helicopter over their grasslands and 20 out of 100 buffalo we see are tagged, what would you estimate as the size of the buffalo population?
- Estimating populations based on mixed sampling information
  - Example: Suppose we tag 100 buffalo and then release them back into the wild in March. Suppose we tag an additional 50 buffalo in June and release them again. If we fly a helicopter over their grasslands and 20 out of 100 buffalo we see are tagged, what would you estimate as the size of the buffalo population?

**Day 3.2**
- Advanced estimating populations based on sampling information
  - Example: Suppose we tag 1000 buffalo and then release them back into the wild. Soon after, when we flew a helicopter over the grasslands, 75 out of 600 buffalo had tags. Further, suppose Jose shows up and each time he goes hunting, he kills 10 random buffalo. Assuming no population change, how many tagged buffalo get hunted after 7 hunting trips?
  - Example: Suppose we have a bag of blue balls. How could you estimate the number of blue balls in the bag? You can only do nothing or add balls to the bag, and you have access to as many blue and red balls as you'd like.
- Classification of objects based on distribution
  - Example: Consider the following charts comparing the sample size, ISAT scores, and family incomes of three different groups: (1) lefties, (2) righties
  - If Jose has ISAT score of 600 and family income of 50,000 per year, which group do you think he belongs to?

- If Nishith has ISAT score of 300 and family income of 75,000 per year, which group do you think he belongs to?

**Day 3.3 — No class (field trip)**

**Day 3.4**
- Consider convex polygons, such as triangles, rectangles, trapezoids, circles
- Calculate the perimeters
- Calculate the areas
- Classification of shapes based on perimeter and area

**Day 3.5**
- Roadmap of what we have done in this class
- Midpoint check-in and questions about anything
- Fun break: finding patterns in interesting series (https://oeis.org/)

## Week 4 — geometry and proportions / rates

**Day 4.1**
- Math story: undecided
- Consider convex polygons on coordinate planes
  - Goal: Forces student to break apart polygon into easier shapes
- Consider non-convex polygons on coordinate planes
  - Goal: Forces student to think about subtracting areas of easier shapes and maybe adding some shapes too, instead of calculating directly
- Ask students to think about their intuitions for a few area formulas

**Day 4.2**
- Ask students to present their intuitions (informal proofs) for a few area formulas in groups
- Translating between proportional shapes
  - Example: Suppose Jose is 6’ tall and casts a 9’ shadow. How long is the shadow of a 10’ lamp post? What if he casts an 11’ shadow?
  - Example: At a restaurant a small burger costs $9 and a large burger costs $16. Assuming no discounts and equal heights of the circular burger patties, if the small patty has area 12π, what would you expect to be the area of the larger patty?
  - Example: Suppose the target logo has three concentric circles, with diameters of length 2, 4, and 6 centimeters, respectively. What fraction of the area is red?
- Discuss the relationships between dimensions and area for different convex polygons

- Example: What is the area of a square of a 2x2 rectangle? 4x2 rectangle? 4x4 rectangle? As we increase one side, how does the area change? As we increase both sides, how does the area change?
- Example: What is the are of a circle or radius 2? Radius 4? Radius 6? As we increase the radius, how does the area change?

**Day 4.3 — No class (field trip)**

**Day 4.4**
- Continue to discuss the relationships between dimensions and area
- Discuss the relationships between dimensions and volume for different convex polygons

**Day 4.5**
- Fun break: undecided

## Week 5 — geometry and statistical thinking

**Day 5.1**
- Review geometry and proportions
- Math story: undecided
- Connect probability and fractional areas
  - Example: Consider a dartboard with two concentric circles of radius 2 and 4. If I throw a dart at the dartboard, what is the probability that I will hit the inside circle?

**Day 5.2**
- Controlling probability with fractional areas
  - Example: If the dartboard has diameter 8, how big should the inner circle's diameter be if we want a 25% chance of hitting the inner circle? What about 50% chance?
  - Example: If you had a 1m x 1m sheet of white paper and a 1cm radius blue circle stamp, how many stamps would you need to cover 25% of the paper? What about 50% of the paper?
- Connect ratios with fractional areas
  - Example: Consider a sheet of paper with a triangle and a rectangle (give dimensions). If 100 rain drops are falling, which shape would you estimate receives more rain? How many drops?

**Day 5.3 — No class (field trip)**

**Day 5.4**

- Connecting ratios with fractional volumes
  - Example: Consider small and large gumballs with radii 2cm and 4cm, respectively. Suppose you need to store 70 small gumballs and 30 large gumballs in a box. What box dimensions would work? If they were stored in a jar, what would the dimensions of the jar be? What are possible shortcomings of your estimates?
  - Example: Consider a jar where small and large gumballs take up 60% and 40% of the volume, respectively. How many small and large gumballs do you estimate are contained in the jar? What are possible shortcomings of your estimates?

**Day 5.5**

- Generalizing these to single-variable equations
  - Example: Consider a bag that can hold infinitely many gumballs with expanding volume. The bag starts off with 100 large gumballs. If we add 25 small gumballs, what percent of the bag's volume is made up of many small gumballs? What if we added n small gumballs?
- Fermi questions
  - Example: How many pizzas will be ordered in your state this year?
  - Example: How many piano tuners are there in Chicago?
- Fun break: guess the number of origami pieces in a jar

## Week 6 — random topics (unfinished)

**Day 6.1**

**Day 6.2**

**Day 6.3 — No class (field trip)**

**Day 6.4**

**Day 6.5**

- Ask me anything
- Fun wrap up