**Chapel Hill Math Circle**
**Session 1 – August 31, 2024:**
**Estimating the World Around Us part 1**
**Beginners' Group (grades 1-3), 10:30-11:30a**
**Mr. Barman** – dilip@trianglemathinstitute.com

*Supplies needed per person: 25 objects like coins, dried beans, or cereal pieces*

Welcome to Math Circle! I teach math at a school I helped to start, Triangle Math Institute, Art of Problem Solving, and summer camps at NC School of Science and Math. I love math circle and teach it here as well as online at Stanford University. I'm excited to work with you!

**How many people live in your home?**

Hopefully this is an easy question to answer. If it's easy, go ahead and answer. If it's not so easy, answer it the best you can and explain what might make it difficult to answer.

**Do you know how many people live in your town?**

The Census Bureau was established because, according to our constitution, we need to take a count periodically of how many people live in our country. Why do you think that may be important?

According to the 2020 Census (data.census.gov), there are 61,960 people living in Chapel Hill, 21,295 in Carrboro, 283,506 in Durham, 174,721 in Cary, 58,780 in Apex, and 467,665 in Raleigh. Is this "too much information"? Is it even correct? How does this compare to towns like those on the next page[1]?

If a relative from another country were visiting you and you live here in the Triangle area of North Carolina, what would you tell them about how many people live here? How would that affect what they might expect on their visit?

[1] pictures from wikipedia.org/wiki/Lost_Springs,_Wyoming (Lost Springs); pinterest.com/pin/499125571172141220 (Agar), and advrider.com/f/threads/your-bike-and-a-small-town-population-sign.913875 (Duncans Mills); each accessed Sept. 29, 2023

LOST SPRINGS
POP 1
ELEV 4996

Agar
POP. 82

Duncans Mills
POP. 85
ELEV. 35
EMERGENCY - CALL 9-1-1

Did you know that there are "population clocks"[2]? You might enjoy with your family visiting census.gov and watching these numbers change. Are they exact?

When I checked on August 29, 2024, the numbers were a little different. What does this tell you?

[2] census.gov/popclock, accessed Oct. 5, 2022 and the second one was accessed Aug. 29, 2024

Let's repeat what we are taking to be (2020) populations for area towns:

- 61,960 in Chapel Hill
- 21,295 in Carrboro
- 283,506 in Durham
- 174,721 in Cary
- 58,780 in Apex
- 467,665 in Raleigh

Even if these numbers were exactly correct, does it really matter? What kind of information does it give us? Would we have any less information if we worked with **approximations** or **estimates** like these?

- 62,000 in Chapel Hill
- 21,000 in Carrboro
- 284,000 in Durham
- 175,000 in Cary
- 59,000 in Apex
- 468,000 in Raleigh

We have **rounded** the numbers to the nearest thousand. Let's practice rounding in class!

Would it be helpful t be even more approximate and say something like:

- 83,000 in Chapel Hill AND Carrboro
- 280,000 in Durham
- 170,000 in Cary
- 700,000 in Raleigh, Cary, and Apex

We have now rounded to the nearest 10,000 and combined a few smaller areas with larger neighbors.

What would a relative who has never been to North Carolina think if you told them that the Triangle area had about (very roughly 100 + 280 + 200 + 700 thousand or roughly 100 + 300 + 200 + 700 = 300 + 1000 + 1300 thousand) 1300 thousand people or about 1 million 300 thousand people? Would adding up the "exact" numbers give any more information? What would they expect if they were visiting cities like the following, with data captured from data.census.gov?

**What's easy to count? What's difficult to count? What's impossible to count?**

Please make 3 lists. Maybe counting your household is easy. Counting the number of people in a small village is also easy but might be a bit difficult if people travel and aren't always around to count. Is it possible to know exactly how many people live in Chapel Hill?

Make three lists and then we'll discuss!

Easy to count

Difficult to count

Impossible to count

**Let's practice some counting and rounding …**

Drop a pile of pennies (or dried beans, cereal, or other small object; be sure not to have a younger brother or sister around as it may be a choking hazard) in front of a partner. Who can more quickly and accurately estimate the number?

How do you "round" to the nearest 10 these numbers? 2, 8, 14, 21, 88, 97, 101?

What does it mean if a car weighs 3809 pounds? What about 4000 pounds?

What if Weaver Street Market has 10 cases of bananas and each case had about 25 bananas?

- Why would some cases have less bananas and some more?
- About how many bananas do they have?
- If they count and find that over 3 days they sell about 988 bananas on average and they get new shipments of bananas every 3 days, how many cases should they buy?

In your neighborhood you notice that there are a lot of families with 2 or 3 children and 2 parents. Every tenth house or so only has 2 adults. If you have about 100 houses in your neighborhood, about how many people live there? How many are adults and how many are children?

If the Town of Cary wants to decide which roads to widen based on which roads are used the most, how should they count how much traffic there is?

What are some things that you would like to be able to count that you aren't sure how to count?

**Keep counting!**

Sometimes the best we can do when we count is to estimate. Try it out. Estimate things like:

- How many people live on your street
- How many children go to your school
- How many slices of pizza your family will eat this month

If you want to be more ambitious, try these activities with your family:

- Watch the US or world (or both) population clocks change over the course of a few minutes or an hour. Based on that can you estimate what the population will likely be in a day? In a week? In a year?
- What information would you need to be able to come up with a good guess about the number of math teachers in the United States?
- How would you estimate the expected number of rainy days in our area over a year? How about the number of snowy days?

Did you have fun today? I hope so! In a future math circle (maybe the next one) we will look at counting things like leaves in a tree, raindrops on a flower, or blades of grass in a lawn. Have a good two weeks – happy almost September!

Enjoy
Mr. Barman

## Notes for Parents

Welcome back to math circle! We had more folks express interest than we had space. I'm glad that you made it and that I get to work with your family!

We will provide all of the materials needed in each class. I recommend that you do have a notebook or binder to keep all math circle materials together, but just showing up is also fine.

**What's easy to count?**

I don't know if it will come up in the discussion, but some households are difficult to count. What if a family has grandparents from another country who live with them half the year? Is it Mommy, Daddy, Kiddos 1 through N, and Grandparents, or 2+N+2, or is it 2+N? But with some possible complexity, it should be fairly easy to count one's household members.

Once we move to any reasonably sized town that becomes difficult or impossible to count. What does it mean that Chapel Hill has a population of 61,960[3]? Is it that exact? Is every single birth recorded? What if somebody moved from Denver to Chapel Hill but was missed in the count? The practicalities of census counting make it impractical to have a 100% accurate count except for very small municipalities.

I look forward to the discussions we will have when children point out items that are easy, possible but difficult, and impossible to count. Sometimes "too much information" (like the Triangle area's population down to the individual vs. saying something like "about a million and a quarter" can be confusing and even misleading.

I love helping children see practical uses of math. Sometimes we don't know – and perhaps don't need to know – an amount but want a rough idea quickly. You may be familiar with "back of the envelope" estimations.

The neighborhood census is a good example. I don't teach multiplication till 3rd grade so won't rely on it. To solve the problem of finding counts of adults, children, and total people in a neighborhood of about 100 houses, I hope that the children will come up with some logic like this:

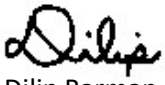
- Let's assume that each house has 2 adults and 2 children; some have 3 but then some homes have no children. That means that 100 houses has about 200 adults and 200 children (we can discuss why 100 2s is time consuming but it's the same as 2 100s), for 400 total.
- Another alternative is to be more detailed. 1st-3rd graders are unlikely to have mastered, if they've even been exposed to, fractions. But that's okay – we solve problems with the tools that we have. So instead of looking at an average of 2 ½ children per home with kids, they guess. Every 10th house

[3] according to the Census Bureau's 2020 Decennial census, data.census.gov/table?q=chapel%20hill,%20nc%20population, accessed Aug. 29, 2024

means 10 houses (we can skip count 10, 20, 30, …, 100 and see that we have 10) so there are 10 2s or 2 10s = 20 adults. Then with 90 houses let's see if they make some assumptions – or give an underestimate of 2 children per home (this calculation will be a bit harder) or an overestimate of 3 children per home. With this approach if the computational complexity proves too difficult, I'll steer them to simplifying their assumptions.

When I was in college I took an interesting physics seminar where we learned about Fermi or order of magnitude estimation. I hope to present this in an upcoming session where we can estimate things like leaves in a tree or cars passing through a bottleneck in a highway.

Till next time! Thanks for being in my math circle!



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P.S. I love teaching fun math classes at a school that I helped to open, trianglemathinstitute.com. Several of our classes this year are full or nearly full, but we have space especially in 2nd and 3rd grades (and geometry). Let me know if you are interested.

Mathematics Institute of the Triangle