Chapel Hill Math Circle

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Session 14 – April 12, 2025:
Making and Spending Money
Beginners' Group (grades 1-3), 10:30-11:30a

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Supplies needed per student: dice, as well as paper and pencil

Welcome to Math Circle session 14. April 15 is just days away and many of your parents will have recently or are about to file "income taxes". Let's get a glimpse into what taxes are and how some years from now you might make and spend money. We will pretend that you have finished college or trade school of some kind and now have a job.

I've wanted to make some sort of game about working with money and finally on April 10 and 11 did it. It's probably not as good as it could be and I thank you for playing it and giving me any feedback of what could make it better.

You can play by yourself but I recommend that you pick a partner and take turns. It would be interesting to see how you each are doing turn-by-turn (each turn is a year so year-by-year). Let's see how much money you will be worth (your "net worth") after 10 years.

Let's start with some background on taxes

Why do your parents file income taxes? Things cost money. When you buy tangerines, you pay some money to a farmer (directly at a farmers' market or indirectly through a store). Who pays to maintain our roads, run our schools, raise armies, count our population, and so much else? We as people living in a country do. Some costs are paid by states and others by the country as a whole. We won't make the distinction here but your family probably pays both state and "federal" (country as a whole) taxes, and depending on where you live, maybe local city taxes too.

What gets taxed? We can decide to tax things that people consume. Maybe when you buy groceries or clothes, you pay a little extra and that goes to the government (local, state, and/or federal). Or maybe taxes are based on how much money your family makes. Maybe taxes are determined both ways. When your family fills out tax forms, they are telling the government how much they made, how much tax they've paid, and what their expenses were. Through complicated rules, your family finds out what its share of taxes is and whether they are due a refund or have to pay more in taxes.

Percents

Taxes are often determined by “percents”. We will not worry much about complicated percents but use some simple ones. 10% means we are divvying things up 10 ways with 1 of the parts being 10%. The trick is just to cut down one zero. For example, 10% of 500 is 50. If you have in income of $123,000, a 10% tax would be $12,300.

Let’s keep things simple. Always start with at least one zero at the end of your number. If you find in this game that you have, for example, $123,456 in your bank account, make it either $123,450 (this is called “truncation”) or $123,460 (“rounding”). 10% takes away a zero. 20% doubles what 10% is and 5% is half of 10%. 15% is 10% plus 5%.

Try some calculations. If you have $200,000, what is 10% of that? What is 20% of it? 5%? 15%?

Hourly rate vs. annual income

When you get a job, you might be paid some money each hour. As of 2025 in North Carolina, the minimum hourly wage is $7.25 per hour[1]. There is a nice “rule of thumb” that people use. If you make, say, $10/hour, double that amount and add three zeros to estimate how much you would make in a year[2]. Try using this rough guide to figure out your annual income if you make $10, $15, $20, $50, or $100 per hour.

[1] labor.nc.gov/workplace-rights/employee-rights-regarding-time-worked-and-wages-earned/minimum-wage-nc

[2] This works because a lot of people work 40 hours a week and 52 weeks a year less 2 weeks of vacation. 40 hours a week for 50 weeks is about 2000 hours.

Did you get these numbers?

- $10/hour means $20 with three zeros or $20,000 per year
- $15/hour means $30,000 per year
- $20/hour means $40,000 per year
- $50/hour means $100,000 per year
- $100/hour means $200,000 per year

Equity

What is fair? That's an ages-old debate that probably never will end. People who like income taxes say that the more money that you make, the more you should contribute to society. People who don't like income taxes argue that there is a "disincentive" to making more money because you will pay more in taxes.

People who like sales or "use" taxes say that it's difficult to put all the forms together and spend all the time figuring out income tax and much easier just to pay taxes slowly over time as you use resources. People who don't like these taxes argue that everybody – poor, not-so-poor, and rich – has basic human needs like food and water and it's an undue burden for the poor to pay taxes on these necessities.

Some people like low taxes and some feel we should pay higher taxes and get more services. In New Hampshire, for example, people have to pay for visiting state parks but they have no income tax. People have decided that those who use parks should pay for them. In Canada taxes are a lot higher than they are in the United States but medical care is free there.

What's the right model? I'll leave such discussions to you and your family as you get older.

Some of the decisions you will be making in the game

You may have heard of **stocks**. A stock gives you a little bit of ownership in a company. I own some stock in Disney. That means that I give Disney money to do what they need to do like running their parks and putting out movies. Disney has a lot of stockholders like me and they are thankful for the money. If they do well, then their value goes up and maybe $100 that I put into Disney becomes worth $140. Or maybe Disney doesn't do well – storms keep their parks closed more than usual and less people visit or see their movies; my $100 investment may now be worth only $75. In the long-term stocks tend to go up in value but they are risky – they can lose all of their value. One of the decisions you will be making is whether to buy any stocks and how much.

If you are being very safe, you may not want to buy stocks as you may lose money. But over time often prices go up (it's called inflation) so if you're not taking some risk and having your money increase in value, in essence you might be losing money; though you are not losing, if everything becomes more expensive, you can buy less. If you do buy stock, you hope that your investment goes up more than prices do.

You'll also decide about **school**. In the game we assume that you have just finished a trade school or college and are moving out and living on your own. Most people go to Kindergarten through high school; some start at preschool. Some continue on to a trade school to learn about auto mechanics or web design or some other job, and others go on to college. I bet most of you will continue to college. But learning doesn't stop there!

After college some people start working and some people go on to graduate school. I worked for a few years then returned to graduate school before coming back to my job. Why do people decide to continue? It may cost some money but it can be really fun and teach new skills so that you have more job opportunities and even the ability to make more money. Maybe you spend $100,000 on graduate school but then your income goes up by $20,000 a year; in 5 years you have paid for your graduate school and after that you are "ahead" financially.

How to start the game

1. Roll the dice to see how much money you start with. Here is what the roll means.
    1) You start with $5000 that you have saved from summer jobs
    2) You start with $6000 that you have saved from summer jobs
    3) You start with $10,000 that you have saved from summer jobs
    4) You start with $2000 that your not-very-wealthy parents gave you
    5) You start with $30,000 that your wealthy parents gave you
    6) You start with a debt of $5000 (you owe the bank $5000; loans accrue interest)

2. Roll the dice to see if you went to college and, if you did, how much debt you have from it. Those who went to college may have more earning potential but may also have more debt. Here is what the roll means.
    1) You finished college debt-free because your parents paid for college!
    2) You have $150,000 in debt from college
    3) You have $100,000 in debt from college
    4) You have $50,000 in debt from college
    5) You got a full scholarship and have no debt
    6) You didn't go to college and have no debt

3. Find out how much money you will make the first year based on whether you went to college or not. Here is what the dice roll means with the notation like ($30/hour, fastfood $10/hour) saying that you would make $30/hour on a job If you had gone to college and otherwise would work at a fastfood restaurant making $10/hour.
    1) This year you will work at a fastfood restaurant making $10/hour whether you went to college or not – that is, (fastfood $10/hour, fastfood $10/hour)
    2) ($30/hour, fastfood $10/hour)
    3) ($30/hour, diner $15/hour)
    4) ($30/hour, small business $20/hour)
    5) ($50/hour, small business $20/hour)
    6) $60/hour, small business $40/hour)

Start filling out your chart. Go on to the first turn (see next section) to finish filling it out for the 1st year. Remember if you have debt like loans for stocks or educational loans to pay 10% interest.

How to play a turn (simulating a year of your life)

Decide if you want to go back to school for more education (it could be a trade school, college, or graduate school). If you do go back to school, you will pay $20,000 in tuition for that year. School lasts for 2 years during which you continue to work half-time. If you were making $100,000 per year before you went to school, you would now make half of that, or $50,000. After 2 years your income will go up by 10%. Skip the next step of checking about your job and rate change if you do choose to go to school.

Are you not in school? Find out if you keep your job and if your hourly rate changes. Roll a dice; here is the meaning.

1) (lose your job [if you went to college], lose your job [if you didn't go to college])
2) (no change, no change)
3) (no change, no change)
4) (your hourly rate goes up by 10%, no change)
5) (your hourly rate goes up by 10%, your hourly rate goes up by 10%)
6) (your hourly rate goes up by 20%, your hourly rate goes up by 10%)

Are you in school? If so you will be in school this and next year. Roll the dice; this is the meaning.

1. You are a teaching assistant and get a stipend of $20,000 for the year
2. $20,000 annual stipend (on top of your part-time working)
3. $20,000 annual stipend (if any part-time working earns you less than $20,000/year)
4. You make no income from school
5. You make no income from school
6. Your family gifts you $5000 to help you get through school

Are you traveling this year? You must travel at least once every three years. Travel will cost you $2000.

Do you want to buy any stocks? You can pay for stocks through savings or by a loan; you have to pay interest of 10% on any loans.

Do you own stock? Let's see how the value changes this year. Roll a dice; this is the meaning.

1. Your stocks increase in value by 10%
2. Your stocks increase by 10%
3. Your stocks decrease by 20%
4. Your stocks decrease by 10%
5. Your stocks increase by 10%
6. Your stocks increase by 10%

Calculate your income tax based on these rates.

1. 0 if your gross income is up to $20,000
2. 10% if above $20,000 and up to $65,000
3. 20% if above $65,000 up to $100,000
4. 30% if above $100,000

How much did you spend this year? Most people spend more the more money they make. Calculate your expenses based on this formula.

- Housing – if you are a student or make less than $25/hour you live with one or more roommates and spend $12,000 on housing
- Food – if you are a student then you spend $6000 a year on food; otherwise if you make less than $30/hour you spend $8000 a year on food; otherwise you spend $10,000 a year on food
- Car – if you are a student you don't own a car but spend about $1000 a year on public transportation; otherwise if you make less than $30/hour you spend $8000 a year on car expenses; otherwise you spend $10,000 a year on car expenses
- Discretionary or optional spending – if you are a student you spend about $1000/year on movies, local travel, entertainment, and other optional expenses; otherwise if you make less than $25/hour you spend $2000/year on optional spending; otherwise you spend $2500/year

Calculate your sales tax. There is no sales tax on housing, on food it is 5%, and on car and discretionary expenses, including travel, it is 10%.

Here are some guidelines:

- You can go into debt. If you end up spending more money than you have in your bank account, write your debt with a minus sign in front of it. For example if you have $1000 and spend $2000 on stocks, you would have -$1000 in cash.
- When you are in debt in any given year, you must pay 10% interest. For example if you are $5000 in debt, you would spend $500 in interest.
- You can't have more than $200,000 of debt. If you do, you go bankrupt and lose any stocks and can't borrow money again for 3 years. Your debt is forgiven and reset to zero.

Game Table

If you are a student, what are you studying and if you are working, what kind of job is it? _____

Starting savings: _____ Starting debt (limit $200,000): _____

Year	Choices (Vac, Stock, School)	Hourly Rate	Gross Income	Income Tax	Expenses	Sales Tax on non-housing expenses	Net Income	Savings after any interest	Stocks	Debt	Net Worth
0											
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

Notes: You must pick Vac (vacation) at least once every 3 years; when you have a year with vacation, it will cost you $2000. When you buy stock, pick the amount that you'd like to buy and remember to pay for it out of savings or by increasing your debt. If you return to school, it will take you two years and cost $20,000, and you will work half the hours you did and make half the income from when you were not going to school. If you are unemployed you get $5000 tax-free for the year from the state government.

Have Fun!
Mr. Barman

Notes for Parents

Financial literacy is an important topic that generally doesn't get much coverage in schools. In homeschool I shared some such topics with my daughter and in my prealgebra and algebra classes I talk about the power of compounding when we study exponential functions and the irrational number e.

I spent a few months in medical school before returning to math and computer science. I saw firsthand there and with ongoing relationships I made with doctors that a lot of training is given of course but after all of that many would go on to open their own practices with very little if any understanding of business or finance.

With tax season upon us, our children may wonder what we are doing. I recommend showing a few forms that you have received, maybe tabulating interest or dividend payments. If you are comfortable, show them your W-2 or 1099 forms.

It's a good time to have discussions as well about how we pay for things both in the small in our households and in the large as a city, state, or country. Do you have a budget? You might share some of the details including the rationale. It's not too early to start planting seeds that later will mature as your child develops her/his own political views – should taxes be kept low or do we want a system where people have many of their social needs covered?

I put this lesson together over two days and hope that it proves interesting and reasonable. I have no doubt that it could be improved with "easier" numbers that work well. I want to focus on the concepts and not have children bogged down on difficult calculations. I'm interested in your feedback about how to improve this lesson.

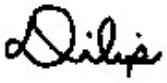
Fun handouts and new classes at Mathematics Institute of the Triangle

By the way a few days ago I put together some handouts and links to videos and published them at trianglemathinstitute.com/math . I encourage you to check this page out and see if there is material, some of which I originated at Chapel Hill Math Circle, that may interest your family.

My school will soon start 2025-6 registration. This year at Mathematics Institute of the Triangle we have offered 2nd grade through high school classes as well as tutoring starting at age 3 and going through college. We may open a 1st grade class next year and may also start offering language arts and science classes. Let me know if you are interested and we can schedule your children for placement assessments.

Thanks for coming to Chapel Hill Math Circle. See you in two weeks for our last session. I am thinking of doing a session on Square and maybe Rectangular Numbers.

Till next time!



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