Graduate School of EDUCATION

Mathematical Agency Improvement Community

*Abolishing the phrase "I'm not a math person."*

# Research Lesson Study Cycle 3
# Memorialization Document

**Team Members**

Marco Aquinde (host), Michelle Fleming, Michael Chin, David Garcia

| Lesson Date: | Instructor: | Grade Level: |
|---|---|---|
| May 20, 2021 @ 11 AM | Marco Aquinde | 8th Math/ Science |

**Summary Box # 1: Title of the Research Lesson**

Living Algebra, Living Wages!

**Summary Box # 2: The Equity Theme and Rationale**

The problem of practice our team explored

How can we support students in recognizing the importance of being a part of the learning process (their own and others) as more important than the right answer or their grade?

Ideas we are grappling with:

- ★ Getting students to value the process of learning and not the end goal of a grade or "the only right" answer.
- ★ How could we support students in clarifying and extending their own thinking?
- ★ How do we build kind, empathetic, and resilient critical thinkers who are comfortable with mathematical risk-taking?
- ★ How will students notice and appreciate the learning process, their own and that of others, rather than the final outcome on an assessment?



*Resource adapted from:*

**The Lesson Study Group**
at Mills College

### Summary Box # 3: Your Team's Theory of Action

The long-term goals for our students and how we will get there

If we employ **collaborative and reflective assessments** while students are making sense of **linear equations** then students will improve the development of their **metacognitive and self-reflective capacities** as evidenced by **students feeling more open to sharing their thinking and listening to others**.

### Summary Box #4: The Research Lesson Topic

Students will apply prior understanding of the slope-intercept form to represent and interpret a complex instruction graphing performance task. They will develop an understanding of the y-intercept and the slope in a context.

Students will be able to… interpret a scenario and provide an accurate linear equation and represent it graphically. Then they will answer the following:

- What does the slope mean in this scenario?
- What does the y-intercept mean in this scenario?

### Summary Box #5: Background and Research on the Content Topic

Marco's Links

- Annotated Bibliography
- Literature Synthesis

Michelle's Links

- Annotated Bibliography
- Literature Synthesis

Michael's Links

- Annotated Bibliography

- Literature Synthesis

Dave's Links
- Annotated Bibliography
- Literature Synthesis

**Major Themes in Our Research**

*Teaching for Social Justice*

Teaching for Social Justice is an instructional approach that is predicated on the development of students' critical consciousness (Freire, 1968/ 2000). It pushes explicit, high-quality instruction about social and educational oppression (Dover, 2009; Leonard et al. 2010). Learning for Justice's development of the Social Justice Standards (2017) further highlights the potential and significance of Social Justice education in the reduction of prejudice and collective action advocacy around justice.

*Complex Instruction + Assigning Competence*

In our research, the importance of disrupting status emerged as an important theme. Complex Instruction is a pedagogical approach, on which Teaching for Social Justice is predicated, and focuses on open-ended, collaborative tasks and the disruption of status. In order to disrupt status, teacher's must highlight student thoughts, noticings, and wonderings as mathematically important. The elevation of student thinking from the teacher serves to disturb any academic or social hierarchies by highlighting the intelligence of all students, not just the academically successful students (Cohen, 1999).

*Reimagining Assessment*

Another theme that emerged was the importance of assessing for learning and not for performance. Students are typically stressed and focused on performance over actual learning. Assessments should prioritize where students are in their learning, where they need to be, and how to get there. (Boaler, 2017; Burns & Frangiosa, 2021).

Boaler, J. (2017). *Aligning assessment to brain science*. https://www.youcubed.org/wp-content/uploads/2017/05/Aligning-Assessment-with-Brain-Science-no-ppt.pdf

Burns, E., & Frangiosa, D. (2021). Assessments. In L. Schleicher & M. Rodriguez (Eds.), *Going Gradeless, grades 6-12: Shifting the focus to student learning* (pp. 47 - 60). Thousand Oaks, California: Corwin.

Cohen, E. G., Lotan, R. A., & Scarloss, B. A. (1999). Complex instruction: equity in cooperative learning classrooms. *Theory Into Practice, 38*(2), 80–86. https://doi.org/10.1080/00405849909543836

Dean, J. (2006). The future of driving: 8th-grade algebra meets rising gas prices and peak oil. *Rethinking Schools, 21*(2), 40-45.

Dean, J. (2013). Living Algebra, Living Wages. In E. Gutstein & B. Peterson (Eds.), *Rethinking Mathematics: Teaching Social Justice by the Numbers* (pp. 67 - 77). Milwaukee, WI: Rethinking Schools. (Original work published in 2007)

Dover, A.G. (2009). Teaching for Social Justice and K-12 Student Outcomes: A Conceptual Framework and Research Review. *Equity & Excellence in Education, 42*(4), 506-524. https://doi.org/10.1080/10665680903196339

Freire, P. (2000). Chapter 2. *Pedagogy of the Oppressed* (pp. 71 - 86). 30th-anniversary ed. New York: Continuum. (Original work published 1968)

Learning for Justice. (2017). Social Justice Standards: The Teaching Tolerance Anti-bias Framework. https://www.learningforjustice.org/. Retrieved from https://www.tolerance.org/frameworks/social-justice-standards

Leonard, J., Brooks, W., Barnes-Johnson, J., & Berry, R. Q. (2010). The Nuances and Complexities of Teaching Mathematics for Cultural Relevance and Social Justice. *Journal of Teacher Education, 61*(3), 261–270. https://doi.org/10.1177/0022487109359927

Lew, M. M., & Nelson, R. F. (2016). New Teachers' Challenges: How Culturally Responsive Teaching, Classroom Management, & Assessment Literacy Are Intertwined. *Multicultural Education, 23*(3–4), 7–13.

Solorzano, D. G., & Bernal, D. D. (2001). Examining Transformational Resistance Through a Critical Race and Latcrit Theory Framework: Chicana and Chicano Students in an Urban Context. *Urban Education, 36*(3), 317–320. https://doi.org/10.1177/0042085901363002

## Summary Box #6: Relationship of Unit Standards

| Prior learning standards that unit builds on | Learning standards for this unit | Later standards for which this unit is a foundation |
|---|---|---|
| **CCSS.MATH.CONTENT.8.F.A.1** *Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.*<br><br>**CCSS.MATH.CONTENT.8.F.A.2** *Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions)*<br><br>**CCSS.MATH.CONTENT.8.F.A.3** Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear | **CCSS.MATH.CONTENT.8.F.B.4** *Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.*<br><br>**JU.6-8.12** *I can recognize and describe unfairness and injustice in many forms including attitudes, speech, behaviors, practices and laws.* | **CCSS.MATH.CONTENT.8.F.B.5** *Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.* |

## Summary Box #7: Goal of the Unit

1. Students will be able to use their understanding of slope-intercept form (rate of change) to interpret the y-intercept (initial value) and the slope in real world scenarios. CCSS.MATH.CONTENT.8.F.A.3, CCSS.MATH.CONTENT.8.F.B.4

## Summary Box #8: Flow of the Unit/Rationale for the Design of Instruction

Students will apply prior understanding of the slope-intercept form to represent and interpret a complex instruction graphing performance task. They will develop an understanding of the y-intercept and the slope in a context.

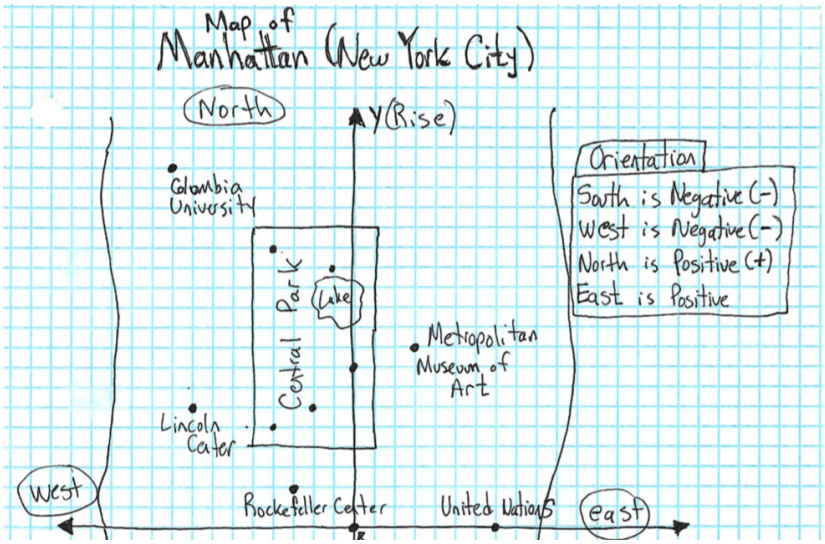
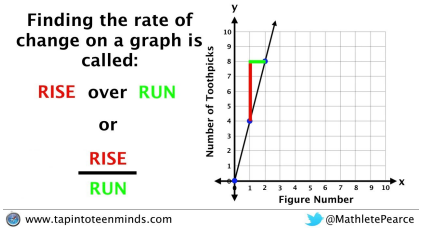
Students will be able to… interpret a scenario and provide an accurate linear equation and represent it graphically. Then they will answer the following:

- What does the slope mean in this scenario?
- What does the y-intercept mean in this scenario?

## Summary Box #9: Unit Plan

The lesson sequence of the unit, with the task and learning goal of each lesson. The asterisk (*) shows the research lesson

| Lesson | Learning goal(s) and tasks |
|---|---|
| **1**<br>Thursday, April 21st | Lesson Goal: Students will play around with the y=mx+b and be introduced to slope-intercept form.<br>Task: Students are introduced to y=mx+b through a Desmos activity where they play with slope and y-intercept sliders to see how changes in those values impact the visual appearance of a line. |

| | |
|---|---|
| **2**<br><br>Friday,<br>April 30th | Lesson Goal: Students will play around with identifying slope through identifying the vertical change and putting that over the horizontal change.<br>  <br><br>Task: Students will play around with a Map of Manhattan and describe the changes in the y-axis over the x-axis as slope.<br>  <br> |
| **3**<br><br>Thursday,<br>May 6th | Lesson Goal: Students will be introduced to slope by calculating the change in y over the change in x between two points.<br>Task: Students will use the same map of Manhattan from Lesson 2 and identify the slope through the following formula: |



*Resource adapted from:*
**The Lesson Study Group**
at Mills College

| | |
|---|---|
| | $$m = \frac{y_2 - y_1}{x_2 - x_1}$$ |
| **4**<br>Monday, May 10th | Lesson Goal: Review<br>$$m = \frac{y_2 - y_1}{x_2 - x_1}$$<br>Task: Students will calculate slope between two points. |
| **5**<br>Thursday, May 13th | Lesson Goal(s):<br>1. Students will see where they are in their understanding of slope and where they need to be.<br>2. Students will identify intervals and begin to interpret a graph.<br>Task:<br>1. Students will complete a "Check Point" participation Quiz<br>2. Students will interpret a graph with coffee and its impact on energy |
| **6**<br>Friday, May 14th | Lesson Goal(s):<br>1. Students will practice in group roles<br>Task:<br>1. Students will complete a "Play with your Math" substitution cipher<br>Flakhs<br>Ukcpnt iqs abcdlpj xluk vt. Thh dqv lp ukh icbb.<br>Bhtt ukcp ukshh, Dqvs Ocuk Uhcfkhst<br>A.T. Ukh rvlfn esqxp iqy mvoat qwhs ukh bczd gqj.<br>Abcd Xluk Dqvs Ocuk.fqo |



*Resource adapted from:*
**The Lesson Study Group**
at Mills College

| | |
|---|---|
| **7**<br>Monday, May 17th | Lesson Goal:<br>1. Given two points, students will be able to identify the slope (rise over run)<br><br>Task:<br>2. Students will complete a Desmos activity with sliders to go visualize slope. |
| **8**<br>Tuesday, May 18th | Lesson Goal:<br>1. Students will begin to contextualize slope in terms of wages earned over hours worked (daily income)<br>Task:<br>2. Students will complete a Desmos activity to visualize the difference in income between college graduates, those who work at Costco, and those who earn minimum wage. |
| **9**<br>Wednesday, May 19th | Asynchronous Day:<br>1. Students will review how to properly name a y-intercept with coordinate pairs.<br><br>Task:<br>1. Students will complete an Edpuzzle assignment |

## Summary Box #10: Content Understanding Goal

- Students will be able to use their understanding of slope-intercept form (rate of change) to interpret the y-intercept (initial value) and the slope in real world scenarios.
- To foster conceptual understanding of the content knowledge, the group activities will be organized around deeper comprehension of the y-intercept

## Summary Box #11: The Classroom Equity Goal (what conditions will be in place to meet your

**equity theme?)**

How can we support students in recognizing the importance of being a part of the learning process (their own and others) as more important than the right answer or their grade?

- Intentional student groupings with group roles emphasized to encourage participation
- Assigning competency
- Highlighting multiple abilities
- Using open-ended questions
- Students will encounter a variety of problems in different contexts in order to have multiple opportunities to grapple with the material and highlight different skills

**Summary Box #12: Scripting the Lesson (Blue text denotes what the teacher will say.)**

**Framing or Launching the Lesson** (connections, context, norms, or objective) (15 min)

Connect Lesson to Prior Knowledge/ Establish Purpose of the Lesson [ min]

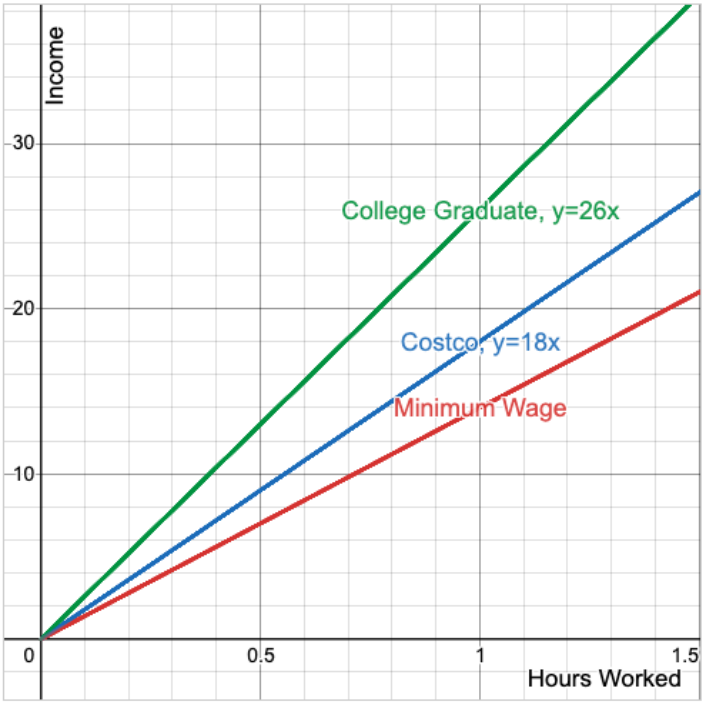
- Folks, please take a moment to log-onto your laptops. Please go to student.desmos.com and enter the code.
- Desmos Check-In: SEL Check-In (2 min)
  - As students come in, they will answer the following prompt: *Which picture of chef Gordon Ramsay best represents your mood at the moment*?
  - 




*Resource adapted from:*
The Lesson Study Group at Mills College

- If you are feeling like 1, 2, 3, or 4, and it's something that you want to talk about, please know that you have adults that care about you and will talk with you if you ever want to.

- Transition to Warm-Up: What do you notice and wonder? Challenge: Can you use the words "y-axis", "x-axis", or "slope" in your responses? (3 min)
- Use time to walk around the room/ check-in with Zoomies about their responses.
- Turn and Talk (1 min): Have the person with the longer eyelashes go first.




  - Focus on Focus Student responses.
    - I noticed that FS1, FS2, and/or FS3 said this. How is this a mathematically important contribution?
    - How do we know that the College graduate makes the most?
    - What does the slope represent in this context? (Anticipate money and income.)
    - Anticipated response: It represents money earned per hour.
- Playing with Slope (1 min)



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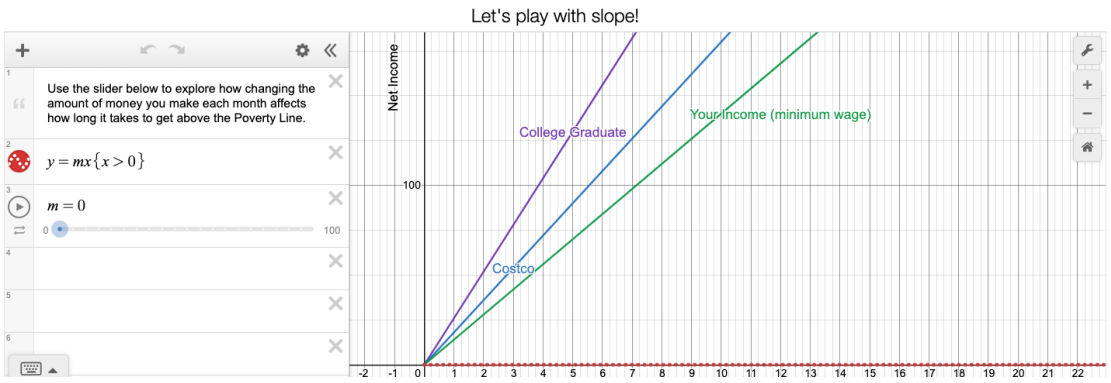



- FS1, please play around with a slider. Class, tell FS1 to stop when you think you've reached the slope that represents the income of a doctor.

**During the Lesson** (35 minutes)

- Today, we will grapple with the following question: Is the minimum wage livable?

Temperature Check (2 min)

From yesterday...


The people who work a minimum wage job are able to support themselves (or meet their basic needs like food and shelter). Do you agree?

- Have a student read the phrase.
- Thumbs up if you agree with the following statement. Thumbs in the middle if you kind of agree. Thumbs down if you disagree.
- Have a few students share their thoughts.
- Today we will talk about whether it is possible to live while earning minimum wage.



*Resource adapted from:*
**The Lesson Study Group**
at Mills College

Getting into groups & assigning roles (3 min)

- Desmos Screen 6:

Your Team!

When you join your breakout room, please introduce yourself and say hello! Decide what roles you would like to take on.

Then, in the box below, please type your teammates' names next to their roles.

The Discussion Guide:

The Skeptic/Presenter:

The Asker:

The Illustrator:

Submit

**Group Roles!**

**1) Discussion Guide:**
Starts by reading the questions to the group when on a new slide.
Makes sure the conversation keeps going in the group by inviting *every* member to share.

**2) The Skeptic/ Presenter**:
Asks clarifying questions when members share.
Will share for the group once they return from the breakout room!
Monitors the chat for comments and questions from others.

**3) The Asker:**
If the group is not able to answer the question, the Asker asks Mr. Marco questions on behalf of the group.

**4) The Illustrator:**
Shares their screen for the group (if you have Zoomies in your group) and will record the thoughts of the group on the activity.
*If you are not the Illustrator, please remain on Desmos. There will be individual slides.*

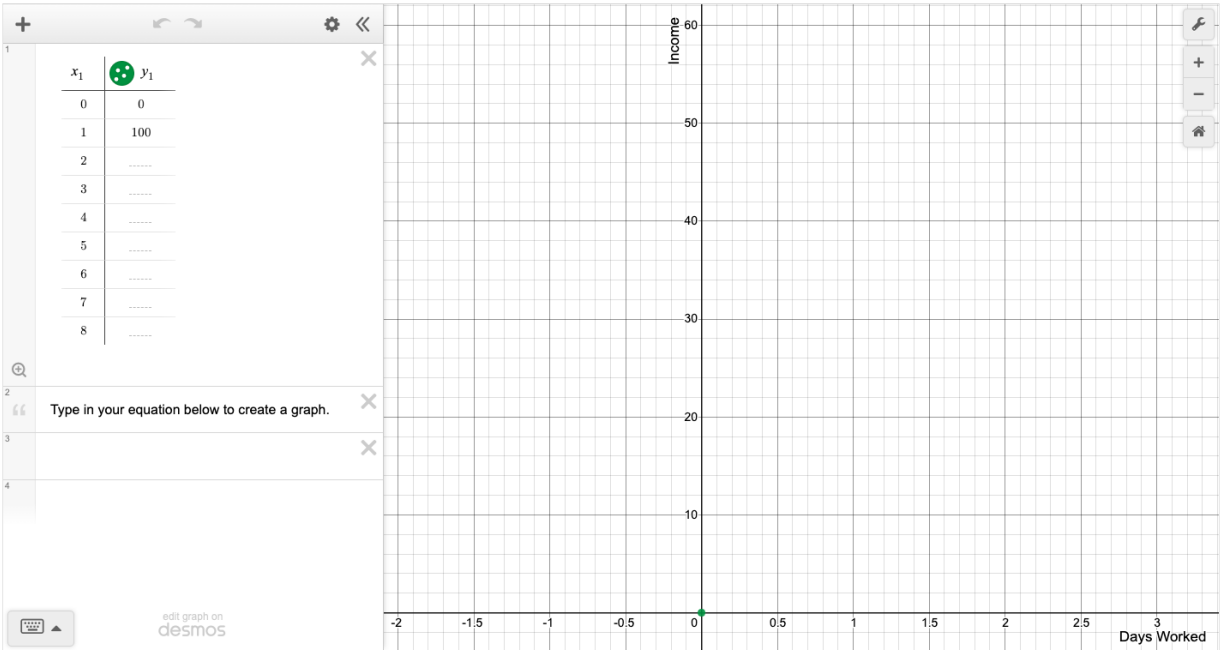
If your group only has three members, The Question Master and The Asker will be one person.

  - You have seen the group roles before! Please take 3 minutes to pick a group role.

How much do you earn with minimum wage? [10 min]

- Desmos Screen 7 (5 min)
- Let's say you live in Arizona, a state with a minimum wage of $12 per hour. This means you earn about $100 every day that you work. Complete the table and equation for this job.

Let's say you live in Arizona, a state with a minimum wage of $12 per hour. This means you earn about $100 every day that you work. Complete the table and equation for this job.




- Fill out the first couple of rows on the t-table. (5 min)
    - You make how much per hour? (Anticipated Response: $12 per hour.) If I work 1 hour, how much money will I make? (Anticipated response: $12.) Awesome! Please fill out the rest of the rest of the table in your groups.
    - Walk around the room and provide assistance as needed.
    -

Minimum wage + expenses [10 min]

- Now, we will take into consideration expenses.
- Have a student read the prompt on Screen 8: "You are someone who just graduated from high school and needs to move out on your own. You found a job making minimum wage for non-tipped employees in the city of Phoenix, Arizona, $12 per hour, as a line cook at a nearby restaurant. You work 40 hours per week."

Desmos Screen 9.

| Expense | Amount |
|---|---|
| *Rent* | $1,000 |
| *Food* | $250 |
| *Utilities* | $170 |
| *Transportation* | $150 |

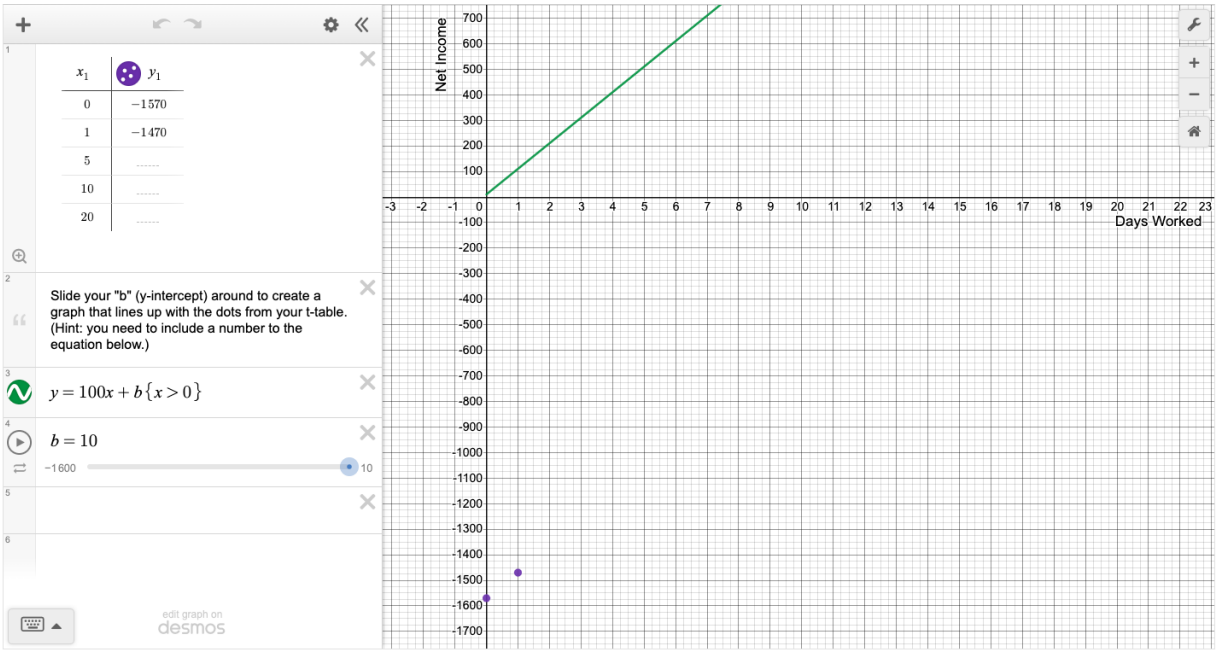
What are your total monthly expenses? (How much do you spend on Rent, Food, Utilities, and Transportation combined?)

Submit and Explain

- Wouldn't it be nice if we could start at $0. But, in reality, we can't! We have monthly expenses to consider. Can you think of any more expenses?
- In your groups, please calculate the total expenses.

Desmos Screen 10:

Complete the table and equation for a job that makes minimum wage (you make about $100 per day). Your bills have already been paid for zero days worked.




- Now, we see that our y-intercept has moved. Remember that we previously had $0 if we worked 0 hours. Now, we have a y-intercept of -$1570. What does this mean?
  - Anticipated Response: That's the same number from our expenses.
- So if we earn $100 per day. How much money would we have in one day? Are we still in debt?
  - Anticipated Response: -$1470. We still owe money!



*Resource adapted from:*
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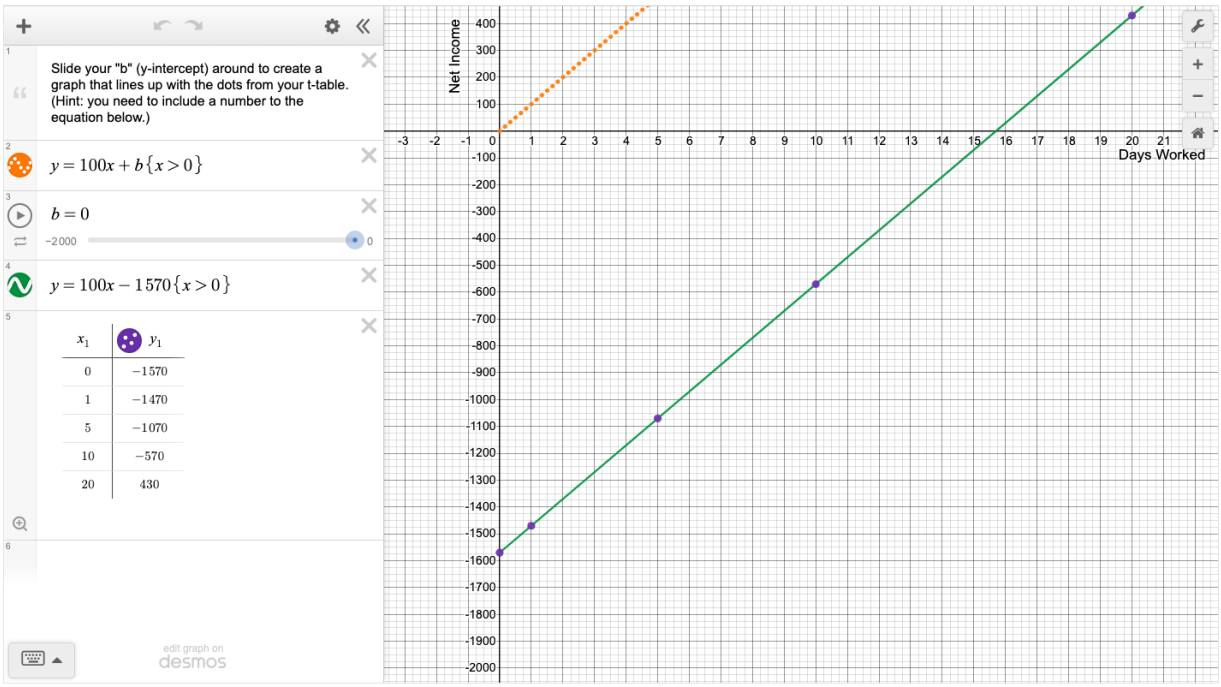
- Please take a moment to fill in the table with your groups.
    - Walk around the room and help as needed.
- What does the y-intercept mean in this context?
    - Anticipated response: This is the money that we start off with every month!
- Right! Why is it negative?
    - Anticipated response: Because we have bills to pay each month!

Playing with y-intercept (Screen 11)

Here is the completed table! Let's slide our y-intercept.

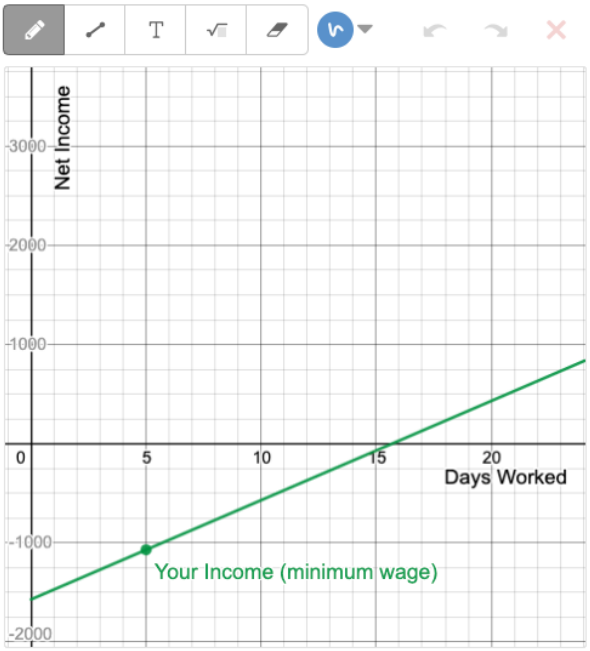



- Have FS2 come up and play with the slider. On average, how much money do you think a college student pays monthly for debt? Tell FS2 to stop when you think you've reached the number!

**Closing the Lesson** (synthesizing, checking for understanding, or connecting to the future) (5 min)

Desmos Screens 12 and 13 [3 min]

Individually... Here is the graph from the previous page again.




This was just for one person supporting themselves. Can you think of other people who might struggle to have a job that only pays minimum wage?

Someone who might struggle with working a minimum wage job is _____

I think this because _____.

Share with Class

Reflection Questions

Has your thinking changed: The people who work a minimum wage job are able to support themselves (or meet their basic needs like food and shelter). Do you still agree/ disagree?

- Agree
- Undecided
- Disagree

How did you or your group approach today's problem or problem set? Was your approach successful? What did you learn from your approach?

One way that my group approached the problem is

Because of this approach, I learned

Submit

- Take a moment to answer the final questions on Slides 12 and 13.

Clean-up and HW [2 min]

- Your homework will be an Exit Ticket with some questions about today's lesson!

**DIFFERENTIATION/ACCOMMODATION**

How might you provide multiple means of representation, multiple means of expression, and multiple means of engagement? Consider how you will meet the needs of three specific focus students (FS), labelled in the key below:

**Key:**

| | | |
|---|---|---|
| FS1: Brilliant student who needs support around confidence | FS2: Brilliant student who needs support with working in groups | FS3: Brilliant student who has lost confidence due to COVID-19 |

**Assigning Competence**

- Highlight FS's contributions as mathematically important.

**Task Variation**



*Resource adapted from:*
**The Lesson Study Group**
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- Students are prompted to participate in familiar activities/routines—Desmos, Think-Pair-Share, Group Discussion

**Sentence Starters**

- Available on the board for all three sections of the Desmos activity, as well as during 1-on-1 discussion with students
- Provides a frame for students to express their thoughts

**Repeating Directions/ What Others Say**

Another student repeats back Desmos instructions
Students also repeat what their peers say to ensure engagement and accountability

**Timer**

Projected with respective slides for certain timed activities

**Familiar People, Places, and Text**

Students familiar with Group Roles and completing a mathematical task together

**Presence of Multiple Adults**

Presence of General Ed teacher, Academic Coach, and Inclusion Specialist to support students

### Summary Box #13: ANTICIPATORY PLANNING

Put yourself in the shoes of your students. Where in the lesson do you anticipate that they will struggle, and why? What questions, about procedures and/or about the content, do you anticipate that they might pose? How will you respond? (Math teachers can also use this more comprehensive anticipatory planning resource.)

| Anticipated Challenges | Responses |
|---|---|
| No participation | Group roles + framing participation as the criterion for success |
| Disconnect between in-person and online students | Thoughtful pairings |
| Lack of content knowledge making it difficult to | • Check points after major parts of the |

| | |
|---|---|
| engage in the lesson | lesson<br>● Using different visuals that show the same data (t-charts and line graphs) and making connections |

### Summary Box #14: Data Collection Plan

- **Desmos**
- **Exit Ticket HW: https://forms.gle/7xzeb6VmCmUvWrLx7**
- **Tracking Participation**

### Summary Box #15: End of Cycle Reflection

*What did the team learn about:*

- *The content concept*
  - Most students felt like they were meeting the learning goal of understanding slope but not yet meeting the learning goal of what the y-intercept represents.
- *Student thinking*
  - We observed that most students were a bit hesitant to share their thoughts in the main room setting, but once they entered breakout rooms and started group work, they were more vocal in the chat or by using their voice. This shows that students are comfortable sharing in small group settings and are well-practiced and comfortable with building upon each others' ideas.
- *Teaching & pedagogy*
  - Having to juggle in-person and online instruction is incredibly challenging. Structures were set in place in the classroom to try to support students in both spaces and it was still hard to be able to reach and hear from all

students during the lesson. Having the small groups contain a mix of in-person and online students gave the online students a chance to be heard and collaborate in the best way possible for these circumstances.

- *Our research question*
    - Complex Instruction, assigning competency, and highlighting multiple intelligences are ways to make students a part of the learning process. As we disrupt status, we create the conditions for students to share their thoughts comfortably and engage in deep, authentic issues (like minimum wage).
- *Our theory of action*
    - Classroom culture is such an important component to having students participate in the learning process and collaborative group tasks and to have them appreciate one and build on one another's' thoughts

*What do individual team members want to implement in their own practice?*

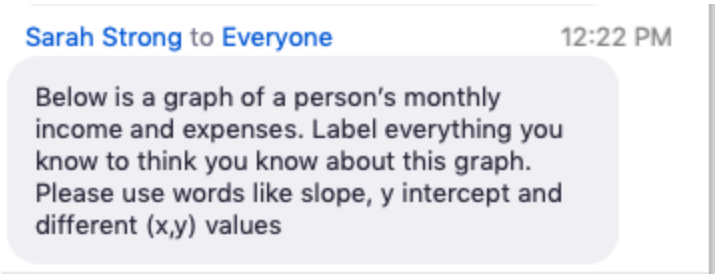
- *MA:* Regularly assigning competence to disrupt status and leveraging student thoughts, noticings, and wonderings to drive classroom discussions
- *MF:* I want to incorporate more Complex Instruction techniques by building in more group work and discussion time. This has been so difficult to do through distance learning. I am looking forward to being in person next year so I can provide more opportunities for students to authentically engage with each other.
- *DG:* In the future I would like to explore the best ways to facilitate group rolls so that they can be most beneficial to students in terms of group work. Also, Teaching for social justice and connecting math exploration to real world scenarios to all/most topics in math would be great as well. Lastly, clearing defining and working towards learning goals is something I would like to work on an I progress into the next years of teaching.
- *MC: This lesson study cycle felt as if it was a culmination of our past cycles and courses as the past core themes are all present in this nested framework. This was exemplified by the use of the findings and structures from my host lesson study in*

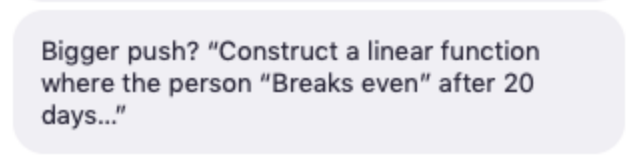
*this lesson. I look forward to continually implementing the lesson study process with my colleagues as I grow in my practice. Next year, I am transitioning into teaching chemistry rather than math for the 10th grade team. This year has prepared me in many ways for this change, and I am excited to introduce the strategies I have learned through lesson study in my new subject. Implementing Complex Instruction is a semester-long endeavor that involves building a strong classroom culture and an extensive understanding of the academic and perceived status of students. I hope to utilize the structures, strategies, and frameworks I have learned this year as they can be applied in any classroom.*

*What is going to happen tomorrow?*

- Continue to work on understanding and contextualizing y-intercept!
- Open-ended task to continue with Complex Instruction momentum: What is everything that you know about this graph?

*Notes from the Expert Commentary - Course Instructor*

- In the design of the lesson, when designing the end, it might be worthwhile to think about how to converge student thoughts (as opposed to ending in a more divergent way) and have that convergence attend to the content understanding goal - Sarah Strong
- 

- 

*Notes from the Expert Commentary - Equity*

- Celebrate the balancing act that is simultaneous learning (with in-person and distance learners)
- Giving Lola competence and highlighting their contribution. It was public, specific but why is it mathematically valuable?
- How effectively are the roles of the group enforced? There are opportunities for more equitable participation such as with Alex and Lola. Which roles felt secondary and which roles felt more important?
- It was harder to find multiple ways of expression knowledge and valuing knowledge with the last activity looking at the graph.