Lesson Designed by Frances Harper & Sheila Orr

| **Social Justice Goals** | **Mathematical goals** |
|---|---|
| 1. Understand why literacy is an important issue for consideration at both a global and local level<br>2. Understand how literacy is defined<br>3. Identify factors that are correlated with illiteracy<br>4. Identify ways to promote literacy at global/local level | 1. Identify and define variables<br>2. Identify coefficients and describe their role in expressions/equations<br>3. Describe covariance<br>4. Write expressions to represent situations or write equations/inequalities to represent the relationship between variables in situations<br>5. Proportional reasoning |

| **Content Standards** |
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CCSS.Math.Content.HSA-CED.A.2 *Create equations in two or more variables to represent relationships between quantities*; graph equations on coordinate axes with labels and scales

CCSS.Math.Content.HSA-CED.A.3 *Represent constraints by equations or inequalities*, and by systems of equations and/or inequalities, and *interpret solutions as viable or nonviable options in a modeling context*. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods*.

CCSS.Math.Content.HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

CCSS.Math.Content.HSF-IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*★

CCSS.Math.Content.HSS-IC.A.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model*?

CCSS.Math.Content.7.EE.A.2 Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."*

CCSS.Math.Content.7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

**CCSS.Math.Practice.MP2** Reason abstractly and quantitatively.

**CCSS.Math.Practice.MP3** Construct viable arguments and critique the reasoning of others.

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**CCSS.Math.Practice.MP4** Model with mathematics.

## Lesson 1: Understanding Variables (60 minutes)

I can
- identify variables that are correlated with literacy
- describe different ways of defining literacy

Launch this lesson by drawing students' attention to the school-wide initiative on literacy. Tell them that they'll be exploring why it is important to focus on literacy. **At this point, it is important to make sure that students have a shared definition for literacy.** You might have them write their own definition of literacy for a "Do Now" and then use this as a talking point about what is literacy? Why does it matter? Then you can transition into thinking about what impacts literacy.

Use ideas from p. 115-118 of *Math that Matters* (Stocker, 2006) to introduce students to the idea of correlation and causation and to introduce using variables to represent the world.

**PART 1 -** On Worksheet 1 (part 1), there is a brief definition of both causative and correlative relationships and some examples. Have students read through these explanations (using **talking to the text:** http://www.cvs.k12.mi.us/mdimitrie/Documents/10-11%20School%20Year/Talking%20to%20the%20Text%20overview.pdf **)**. You might check their understanding by asking them for some other possible explanations of why eating a chocolate bar and your test score might be correlated. You might also ask them for some more relationships that they think are causative, but then try to unpack other reasons that the two variables might be linked (to show how difficult it is to prove causative relationships.) You could do this as a whole class, or you could have them think about these questions in groups.

**At this point, it would be a good idea to start keeping track of new vocabulary words. You could put this on the board or a wall, and keep them there throughout the unit. Some of the definitions of these words might change (such as "variable" and "literacy" because different meanings will be used at different times) but others will stay the same. I've tried to list relevant new vocabulary (or vocabulary to revisit at the end of each lesson.**
After the discussion of correlation and causation, there is space on the worksheet for the students to **hypothesize** some variables that they believe are related to literacy and some possible reasons for those relationships. They should keep this as a reference for later so

they can compare their original hypothesis to what they find in the data.

**PART 2** – On worksheet 1 (part 2), there are four questions for students to consider as they look at some data on literacy. All of the data comes from the following websites (http://www.dosomething.org/tipsandtools/11-facts-about-literacy-america, http://www.degreescout.com/featured/understanding-illiteracy-infographic, http://www.alternet.org/education/teachers-make-handy-scapegoats-spiraling-inequality really-what-ails-our-education-system?page=0%2C0 and



http://www.languageandliteracyforall.org/literacy/reading-for-life-the-povertyilliteracy connection/ ). I would recommend assigned groups to look at different sets of infographics and "facts". This will give them enough time to make sense of and discuss each one in their groups, and then they will be sharing something new with their classmates during the discussion. I've put all of these on worksheet 1, and you can decide how to break them up for groups. **Talking to the text can be used again here, with an opportunity to introduce the idea that text (and literacy) can involve more than just understanding written word.**

Although many other things may come up that are important, you might choose to focus the discussion on the following:

- **Understanding of variable**: when talking about the relationship between variables, they are "variable" because as one changes the other changes. This is the *covariance* definition of variable. For example, with this "fact":

Nearly 85 percent of the juveniles who face trial in the juvenile court system are functionally illiterate, proving that there is a close relationship between illiteracy and crime. More than 60 percent of all inmates are functionally illiterate.

  you might talk about how as crime decrease, illiteracy should (theoretically) also decrease.

- **Defining variables**: It is important to consider how we define variables (in studies and in mathematics problems). As you look across the data, you'll notice that sometimes literacy is defined as a 5th grade reading level, sometimes 4th grade is referenced, and sometimes it isn't defined at all. This will also be an important time to bring attention to whose vocabulary is valued. In reference to 1st graders from low income families having a lower vocabulary, you might ask the question of how vocabulary is defined. This will help to avoid deficit views of these students. They may have rich vocabularies, but not necessarily words that are recognized as 'academic' words. You might ask students for examples of vocabulary words that wouldn't get counted in measuring literacy (slang words, words in different languages, etc.).
  - If students are really interested in this idea, you might have them take a look at the Bronx SAT. This is a 'SAT' exam created by students in the Bronx (NYC). The exam captures knowledge that students in the Bronx need to live their daily lives, but knowledge that isn't valued on standard exams, etc. There is a vocabulary list at the beginning of the exam. There's also a math section. The whole exam is available as a PDF: http://www.whatkidscando.org/pdf/SAT%20Bronx.pdf

- **Correlation**: This is also a good opportunity to reinforce that these relationships are correlative, and to ask students to hypothesize why these relationships exist. This will be important for upcoming lessons. This will be important also for avoiding deficit views. For example, why does Africa have the lowest literacy rates in the world? Are students familiar with apartheid? It might be interesting here to think about the

relationship between slavery and a legacy of illiteracy (i.e. relationship between race, poverty and illiteracy even in the US).

- As much as possible, try to anticipate what students might say is related to literacy and think about how you might avoid negative views. Poverty. Not everyone is represented in the books. Learning disabilities. The teachers aren't helping. We don't read at home. The books aren't interesting. English isn't my first language. --- This might be important to explore as you raise the



question of the ability to be literate and read in one's first language. Pass out books in a foreign language and ask students to read. Then tell them that you've deemed them illiterate. Talk about how the statistics may not be an accurate measure. (I have some books written in Japanese if you'd like to borrow them.)

By the end of class, students should have a list of variables that are correlated with literacy, and some possible explanations of why those correlations exist.

| **Vocabulary** |
| --- |
| Variable, literacy, illiteracy, correlative relationship, causative<br><br>relationship Optional: hypothesize |

## Lesson 2: Using Variables and Variable Expressions to represent the world (90-120 minutes)

I can

- Choose and define appropriate variable to represent situations
- Write appropriate variable expressions or equations to represent situations
- Calculate percentages

Launch this lesson by connecting to the many variables that students identified in the previous lesson. Over the next few days, they'll be exploring one idea in depth:

PART 1 – (10 minutes) – Have students listen to the NPR article (they can read and follow along if you print about the article). Encouarge students to talk to the text (whether it is audio or printed.) http://www.npr.org/blogs/codeswitch/2013/06/25/193174358/as-demographics shift-kids-books-stay-stubbornly-white?ft=1&f=1032

Have students reflect on the following statistic that is presented at the beginning of this article:

**A report by the Cooperative Children's Book Center at the University of Wisconsin Madison found that only 3 percent of children's books are by or about Latinos — even though nearly a quarter of all public school children today are Latino.**

What does this statistic mean? (*Don't worry too much about this. They'll be exploring that in

more detail in Part 2. Here, you might focus on unpacking what the variables are and what they mean). And why might this be important based on the variables correlated to literacy that we talked about yesterday?

PART 2 (80 minutes) – For this part of the lesson, it might be helpful to read *Developing students' understanding or variable* by Ana Stephens (2005). <See included PDF> This lesson is based on this article.

Literacy data is taken from http://ccbc.education.wisc.edu/books/pcstats.asp, and it may be useful to read this in full so that you are familiar with the background information about data collection. I have already reformatted the data so that students are working with percentages



rather than raw data. If you want to work on proportional reasoning here, you might ask students to do the calculations themselves (or at least verify the calculations.)

(Part 1 of worksheet 2) You might want to model the situation for students by having two boxes and 10 books, going through a few examples (from the students) of ways to sort the books. (This seemed really important for understanding when we enacted the lesson). Then you can ask them to think about how they'll represent that situation on paper. Encourage them to use multiple representations of the situation. For example, they might draw two boxes and show all the books being sorted in the different ways; they might make a table to systematically determine the number of ways to sort the books; they might represent the situation with a variable expression.

*It might also be relevant to talk about the language choices in the worksheet. What does "people of color" mean? Is there anything problematic about using this word? (Yes, of course there is…this assumes that all people of color – Black, Lantina/o, etc. have the same experiences, issues, views, etc.) When we enacted the lesson, many students shortened this expression to color (using C as a variable). This might be worth noting here, given the historical use of the word "colored."

In the discussion, have students present different representations. If one group (or student) has used a variable expression, ask this student to present*. Use this representation to highlight:

- What each variable means
- How the expression/equation shows the relationship between the two variables
- Other ways to represent the situation
    - **Use "fact families" to generate equivalent equations: x+y=10, y+x=10, 10-x=y, 10-y=x**
    - **You might confront a common misconception here that x and y cannot be the same value by asking, "Can x=y be true?" and asking students to justify**

*If none of the students spontaneously produce algebraic expressions, you might ask, "What do you notice about this table? Do you notice any patterns?"

(Part 2 of worksheet 2) – In this section, students guess the most likely scenario based on what they heard in the NPR article. Then they calculate the percentage of books about people of color for the scenario they choose. They'll compare this percentage to the actual data in Part 3. (As such, you might want to give them access to Part 3 only after they've completed Part 2).

(Part 3 of worksheet 2) – OPTIONS - You can simply present the actual data and ask students to compare their guess. Or you can ask them to create a new algebraic expression for these two scenarios and calculate the values and/or percentages for books about and by White people. This may depend on how much time you have, but it could be interesting for them to calculate a few and realize about high these numbers and percentages actually are! I didn't include instructions on the worksheet because I wanted to leave the option up to you.

PART 3 (optional) – (30 minutes) – Have students watch the video "The danger of a single story" http://www.ted.com/talks/chimamanda_adichie_the_danger_of_a_single_story.html
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Ask them to write down their ideas about how this might relate to literacy rates. If students read a 'single story' in school, how does that impact literacy rates? Also, looking at the statistics from Part 3, on worksheet 2, what do you think might be danger of having white authors publish books about people of color? You could have students calculate what percentage of books about people of color are written by white authors.

OPTIONAL LESSON – You might want to have students revisit the patterns from the first unit to practice defining variables and creating variable expression/equations based on scenarios they are already familiar with.

| **Vocabulary** |
| --- |
| Variable, expression, equation, fact family |

## Lesson 3: Constructing a convincing argument (60-120 minutes)

In this lesson, students work in groups to gather more data about a variable that is correlated with literacy. You may wish to group students based on the variable of interest. The sources and directions of their research will depend on which variable they identify. But the goal is for them to create a presentation of their findings for their peers. This presentation should also include a proposed action that the class or individuals could take to make a difference. The class can vote on which action they would like to follow through with.

Launch this lesson by talking about the following study:
Fryer, R. G., & Levitt, S. D. (2006). The black-white test score gap through third grade. *American Law and Economics Review*, *8*(2), 249-281.

Black children enter school substantially behind their White counterparts in reading and math, but including a small number of covariates erases the gap. This means that essentially, achievement at kindergarten can be considered the same for both Black and White students. Over the first four years of school, however, Blacks lose substantial ground relative to other races. By the end of third grade, there is a large Black-White test score gap that cannot be explained by observable characteristics. Blacks are falling behind in virtually all categories of skills tested, except the most basic. **None of the explanations we examine, including systematic differences in school quality across races, convincingly explain the divergent academic trajectory of Black students.**

The researchers were not able to identify any variables that convincingly explained the

differences in achievement, including literacy scores. What can you find in your own research that you think is convincing? What can you do as an individual or as a whole class to make a difference?

Students may choose to do additional research from articles they find online (using Worksheet 3). Or they may consider whether or not the books in their school library represent the school population (a further exploration of ideas from Lesson 2; using worksheet 4).

Use discussions from the finding of this project to propose factors that might contribute to correlative relationships.

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*By the end of this lesson, students will be able to create expressions that show how literacy is related to other variables.*

- Each group presents algebraic expressions or other representations that show the relationship between literacy and one other variable
    - They explain what the variables and expressions mean
    - They explain why they think these relationships/factors are important to consider
        - They present evidence about why they think this relationship exists and propose one action that they class could take to make a difference
    - Possibly….students vote on the action that they think will make the most impact and they work together to take that action

    Potential actions: present at the school board and argue for more/different resources in the library; start a reading club for pre-school aged students in their community – elementary school across the road to read with the kids