Bulkeley HOT Lesson

Chapter 3 – section 4

Title: *Who gets how much?*
How can we use proportions to investigate poverty in the world?

Grade Level and Course: Algebra – grade 9

Time Frame: 2 class periods
GOAL DAY 1: address: How do we know which region is more wealthy, and how wealthy? How do we compare to draw conclusions?
GOAL DAY 2: address: How do we model the distribution of people and wealth in our class and confirm what we thought about yesterday? Raise issue of fairness: Is the current distribution fair?

Prior to lesson:
CONTEXT: Build background with respect to various countries. Find out where students are from, or where they have relatives, or where they have visited. Discuss with the students' social studies/geography teacher doing something to familiarize students with different countries/continents. Talk about the idea of *distribution* and *wealth* (one option, using the article on George David's wife's expenditures (from Steve) at http://www.courant.com/community/news/hfd/hc-david1218.artdec18,0,4768262.story
MATH: Students should have some background with proportions. Students should understand that proportions is one math tool that can be used to make comparisons. Proportions offer a way to measure/quantify so comparisons can be made. (This is also further developed in the lesson.)
Other areas that are helpful to have students work on and be familiar with prior to the lesson include:
Finding percents, including # and % of girls in class, boys in class, etc. (sets up modeling in Day 2)
Doing a problem with a chart and finding ratios and interpreting their meaning (e.g., Country and Population problem (from Natasha) – perhaps with some different questions; or looking at the hourly rate A-Rod's salary)
Look at a graph where 1 stick figure represents X people

Content Objectives:
- Students will be able to determine the percent wealth and population of various geographic regions by using proportions
- Students will be able to determine which geographic region are more or less wealthy by comparing the wealth and population using informal reasoning and formal calculations
- Student will make connections between the world's wealth and population distributions and the class model for the distributions (requires reasoning proportionally and scaling down)

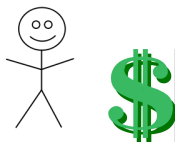
See also Higher Order Thinking below

Language Objectives:
- Students will become familiar with the following vocabulary terms
    - distribute/distribution (distribution of wealth)

    - Gross Domestic Product (GDP)[1]
- Students will be able to engage in verbal discussion of the distribution of wealth
- Students will be able to explain which geographic region is more or less wealthy by comparing the dollars (GDP) and population
- Students will be able to write a brief reflection about social impact of the distribution of wealth

Higher-Order Thinking:
- Students will reason about *relative quantities* as they discuss the wealth of various regions. Specifically, they will be able to *informally* reason to compare the relative wealth (not absolute) of a region based on the number of people and GDP, and they will be able to *formally* compare by calculating and interpreting the ratio of $/person to determine which region is richest and which region is poorest

Materials:
- slide show comprising pictures from around the world of people living in various conditions
- large map of the world, or digital map and projector
- smaller map for each student for reference
- a set of icons (~ 25) to represent population (e.g., stick figures)
- a set of icons (~ 25) to represent wealth (e.g., dollar signs)



- 25 treats
- World Wealth and Population Table
- Large chart identical to the WW&P Table students will be given (can be part of ppt presentation); this will be filled in as a class
- Slips of paper with "I live in Africa" "I live in Europe" etc., cut up (in a bag or hat for students to draw) (handout is geared for distribution if there are 25 in the class)
- Names of each region/continent to place in different parts of the room/on different tables
- Exit slips
- Calculators

Initiation:
"We're going to start today's lesson with some pictures from around the world… We've been working on proportions. Today we're going to look at how proportions, one of our many math tools, can help us investigate poverty around the world?...

[1] Here are some working definitions:
Wealth is the value of all of your assets at any one time
Income is the money you receive in a given period of time (e.g., 1 year). It basically describes how much money someone makes.
Gross Domestic Product is total amount of spending done in one year by a country's consumers, businesses, and government. It's a good proxy for wealth.

On first powerpoint slide

How many people do you think are living on this planet? *How much wealth do you think the people of the world have all together?* *Which region(s) do you think are the richest? Which regions do you think are the poorest?*

(note: If we use GDP in the data table, the question we'll be working with is "How much spending happens on this planet in one year?")

Ask students to write down their answers/estimates.

Ask students their values for #1 & #2. Give students the actual values.

- 6,602,000,000 people (6 billion, 6 hundred two thousand)
- 55,653,000,000 dollars spent each year (55 trillion, 653 billion)
- For qu 3 above, explain that's part of what we will explore in today's lesson. (Can ask – how would we know? How could we determine if a region is wealthy? What would that mean?)

- Tell Slide show – depicting images of people living in a variety of conditions in several countries. Pictures are "paired", showing representations of wealth and poverty in the country.

As discussing 3 questions:

- Get at the idea of distribution – Are people evenly spread about the whole world? Where are there a lot of people? Where are there not many? Is the money evenly spread across the world? Which are the richest countries? (How would we know?) Are there big differences? How do we define the wealth of North America?
- To help students understand the idea of distribution, can use reference points of distributive property and distributing one's attention (to different students in the room)
- Let students know that through math, they will be exploring inequities regarding wealth and today, they will be exploring the distribution of wealth in the world.

Transition to giving table:

- I'm going to give you information about the population of different regions in the world and the amount of money they spend in a year. This is called **Gross Domestic Product** (GDP).
- Hand out the Population and World Wealth Worksheet and calculators.

Whole-Class Discussion – Making sense of the table and discussing how to determine the distribution of population (by using %):

- As a class, identify the different continents/regions listed on the handout. Use map.
- As a class, discuss how to read the table. The following are some questions to ask students:
  - What do we know from reading the data table?

- What are some of the table headings?
- What information don't we know?
- Discuss the idea of **gross domestic product** with students. This is a measure of the **spending** of a country/region – its people, its businesses and its government. Explain that this is one way to measure the wealth of a country/region.
- Possibly ask: Does it look like the wealth of the world is evenly distributed? How do you know?

- **Informal reasoning:** Ask students questions that will prompt them to informally reason about the relative wealth of one or more regions.
- **E.g.**
  - Which region looks like it's the richest? getting at their relative thinking; perhaps press on absolute thinking) *A student may think Asia is the wealthiest b/c it has the largest GDP. The student is then only considering the absolute $ amount, and not thinking about the impact population would have.*
  - Which regions look richer, ____ or _____? (This idea will be raised again.)
- If students need additional scaffolding, make analogy to a family – you have 2 families, same $; one family has 2 kids, one has 5 kids… Emphasize the need to ***compare*** the amount of money with the number of people.
- Get students thinking about the wealth of a country/continent ***compared to*** the population. For example, suppose the US and Cuba had the same amount of money. Are they equally rich? (No, Cuba would be wealthier because they have fewer people.)
- Explain that you're going to use math tools – ratios and proportions - to help compare and determine which regions are the richest. The first task is to determine where people live, specifically, the percentage of people that live in each region in the table. (Explain that tomorrow you are going to represent that in the classroom.)
- Ask students how to determine the % of World Population for Africa. Ideally a student can explain how to do the calculations and why they make sense. Complete the chart. Write in values on large chart on poster paper (or on white board/chalk board)
  - (Region's Wealth / Total World Wealth) = (% / 100)

Pair Work:

- Let students complete the % of World Population and % of World Wealth

- If students are done, let students share and check their answers with another team. Record values on class chart.

Whole class (using math tools to revisit earlier questions)

- Ask again whether the wealth in the world seems equally/evenly distributed. Elicit student reasoning. (They might now use the percentages to make the argument, e.g., Asia has __% of the people but __% of the wealth.)
- Ask again: Which region is wealthiest? Poorest? How do you know? Elicit student reasoning
- Ask students to *rank* the regions from wealthiest to least wealthy. Ask them how they could do this? Let pairs talk for a bit. Share strategies as a whole class.
- Ideally there are multiple methods. One method is calculating the $/person for each region. The larger this ratio, the wealthier the region is.

Closure

- Hand out Exit slip
- Collect Tables and Exit slips (or tell students they must bring back their tables for tomorrow)

END DAY 1:

DAY 2: Modeling and discussion of fairness

Whole-Class Discussion: Modeling the distribution of world wealth and population in the classroom.

- Discuss idea of modeling. Tell students that they are now going to demonstrate how wealth and population are distributed by continent.
  - **Key Question** If our class was the world, how many of us will represent the population of each continent?
    - *Students may find this question very challenging. Here are some options for scaffolding.*
    - Have them think about the whole: If all of us is ___ (have fill in table so see __ students is 100% of the world pop)
    - Informal reasoning about a region – ask, How many people in our class are needed to represent the population of ____? Ask if it's more or less than half, etc.
    - Focus on one country
    - Ask students to talk to a partner for 2 minutes

- Multiple choice - give options for how many students are needed to represent a particular region. For example: Which makes sense for the number of students we need to represent the population of Asia: 1, 10, 15 or 20?
- Idea of a map of model – draw analogy.

- As a class, or in pairs, have students think about how to complete the # of Students column. Two methods:
  - Find number of students by setting up proportions. Discuss with students how to set up the appropriate proportion and/or use percentages. When they get results, ask if the results make sense.
  - (# of students / total # of students) = (Region's Population / Total World Population)

    or
  - take % of world population for the region * # of students in class

Individual work: Complete chart (or assign different pairs to do different calculations)

Modeling – population distribution:

- Based on values from chart, put *I live in…* slips of paper in hat
- Each student randomly picks a slip of paper "*I live in…*" and moves to a specified area of the room. Let students know that they cannot trade slips. Have students go to a designated area in the room for that particular continent. After students are in their areas, remind students that they each represent a part of the world population.

Modeling – wealth distribution:

- Ask if they think their region is one of the richest or the poorest, or ask which regions seem to be richest, who is poorest. *See if students can offer relative arguments, confirm what they did yesterday e.g., Asia has more than half of the people, but less than half of the wealth, so they are not the richest. – or – US/Canada and Europe have about the same wealth, but Europe has almost twice as many people, so the US/Canada must be wealthier than Europe*
- Students in each region calculate the number of treats their region/group should get in order to model the distribution of world wealth.
  - If 25 pieces of candy represented the wealth of the world, how many pieces of candy will each region get?

    - Find the number of treats by setting up a proportion. Do not give students the following immediately. Discuss with students how to set up a proportion and then put on the board the more general set-up for the proportion.
    - (# of Treats / Total # of Treats) = (Region's Wealth / Total World Wealth) or use percentages
- Monitor each group
- Each region (or a representative from each region) puts the appropriate number of icons on the map to represent its population (stick figures) and its wealth ($).
- When students are done, go over the answers as a class. Make sure values make sense.

-- Distribution of World Wealth Negotiations:

- Show students a bag with treats – this is the World's Wealth/(Spending in one year).
- Explain to students that once the bag of resources is passed out to a representative from each continent, each group needs to sit in a circle and discuss the situation. Tell students that there will be a cross-continent negotiation session, then a time for the traveling negotiators to return to their home base to discuss their negotiations with the rest of the group, and then finally a time for any trading or donating of resources.
- Distribute the world's wealth, in this case, the treats to each continent in accordance with the table. Announce how many treats are given to each continent.

This next component we thought we would not have time for. I've left it in in case you find you have time and want to do this component.

- One person from each group should be the "traveling negotiator" and give this person a sign stating so.
- Start the traveling negotiation session. Tell students that they should sit in the circle of the other continent and discuss the distribution of world wealth and what should/could be done about it.
- After 5-10 minutes, let the traveling negotiations return to their home regions. The traveling negotiator should now discuss the negotiations with the other members of the group.
- After a few minutes, let the trading and donating sessions begin. Regions may trade/give their own treats to the traveling negotiators of other continents.
- After a few minutes of trading/giving resources, have the traveling negotiators distribute the treats amongst the members of the group.

- As a continent/region, students should discuss what they think the distribution of wealth should look like. Hand out slips on which students can record their thoughts.

Distribution of World Wealth Discussion and Debrief (whole class format)**:**

- Questions to ask students:
    - How did mathematics help us understand which regions were rich and which were poor?
    - What does the inequality of wealth mean in terms of the kinds of lives people lead?
    - Should wealth be distributed equally? What would be fair? (Is the system fair? Is equal the same as fair? Is equal always fair?)
    - Do you think that, within a particular continent/region, wealth is distributed fairly?
    - How does the unequal distribution of wealth affect the power that groups of people hold?
    - What can be done about the unequal way wealth is distributed?
    - Questions potentially for social studies teacher: How did the distribution of wealth get to be so unequal? Who do you think decides how wealth is distributed?

Closure:

- Hand out the Exit Slips. Give students 5 minutes to answer the questions.
- Collect all of students' work.

Resources:

- Rethinking Mathematics: Teaching Social Justice by the Numbers (page 64-67)
- Lesson as developed by J. Corbishley, R. Reese, & L. Tran for their *Math That Matters* unit