

# How Students Learn Math



# Problem

- I have a budget of \$10.00 dollars. I work at a basketball camp and need to buy two new basketballs. Each basketball cost \$4.00 dollars. Do I have enough money? (Self)
- How much money do I have left when I buy the basketballs? Explain how do you know? (Partner)

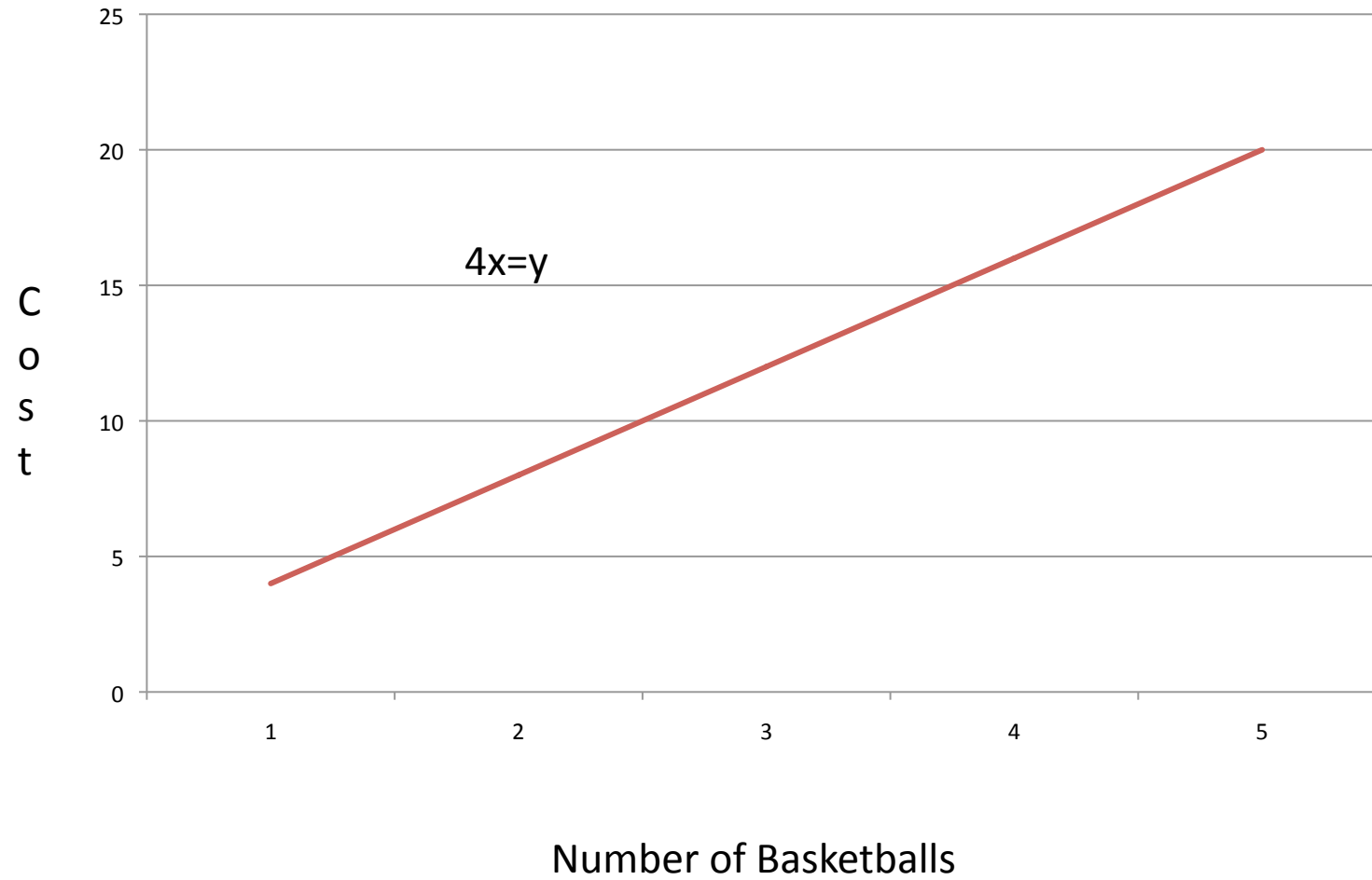
# Problem

- Please create an equation that will let me know if I have enough money to buy any number of basketballs I choose. (Partner)
- For example do I have enough for 7 basketballs? For 10 basketballs? Write an equation that I could use to help figure out the cost.

# Problem

- Can you please graph the equation that shows the relationship between the number of basketballs bought and the cost?
- Given the equation  $4x=y$ , can you please graph the linear equation where  $x$  = number of basketballs and  $y$  = cost. (complete alone)

# Solution



# Key Points

- Position of learner – How Does it feel?
- Math over time – Progression of skills
- Progression of cognitive, algebraic and arithmetic

# Cognitive Learning

- Mathematics is cognitive process-thinking-that requires the dual coding of imagery and language. Imagery is fundamental to the process of thinking with numbers.
- “If I can’t picture it, I can’t understand it.”  
Albert Einstein
- For the people who “get” math, the language of numbers turns into imagery.

# Answers from students

- 1<sup>st</sup> grader – “I know to use subtraction because when you sell someone something you are taking things away.
  - Used basic arithmetic
  - Imagery
- 6<sup>th</sup> grader  $\frac{4}{h} = \frac{10}{12}$        $\frac{4}{12} = \frac{7}{r}$

They image the concrete and attach language to their imagery. The integration of imagery and language is then applied to computation.



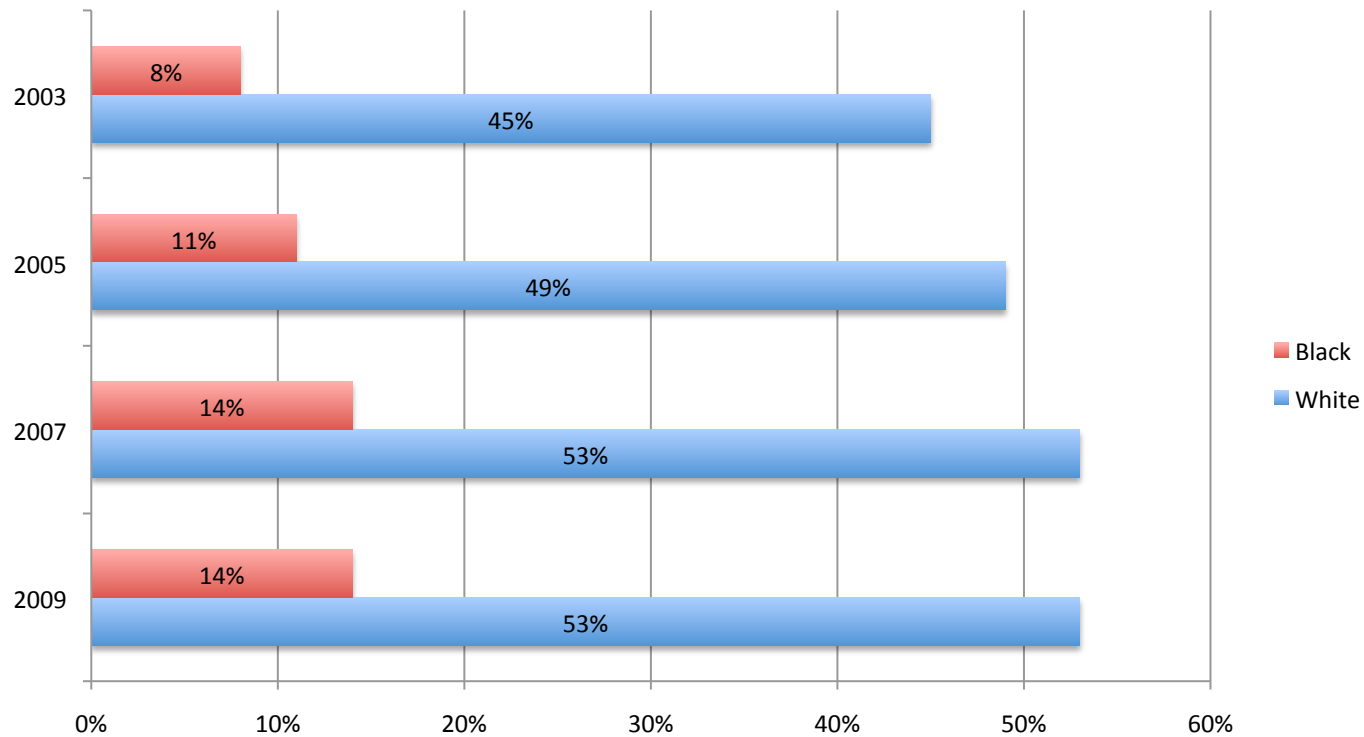
# Math is a Dual Language

- Arnheim (1966) wrote, “Thinking is concerned with the objects and events of the world we know...When the objects are not physically present, they are represented indirectly by what we remember and know about them... Experiences deposit images.”

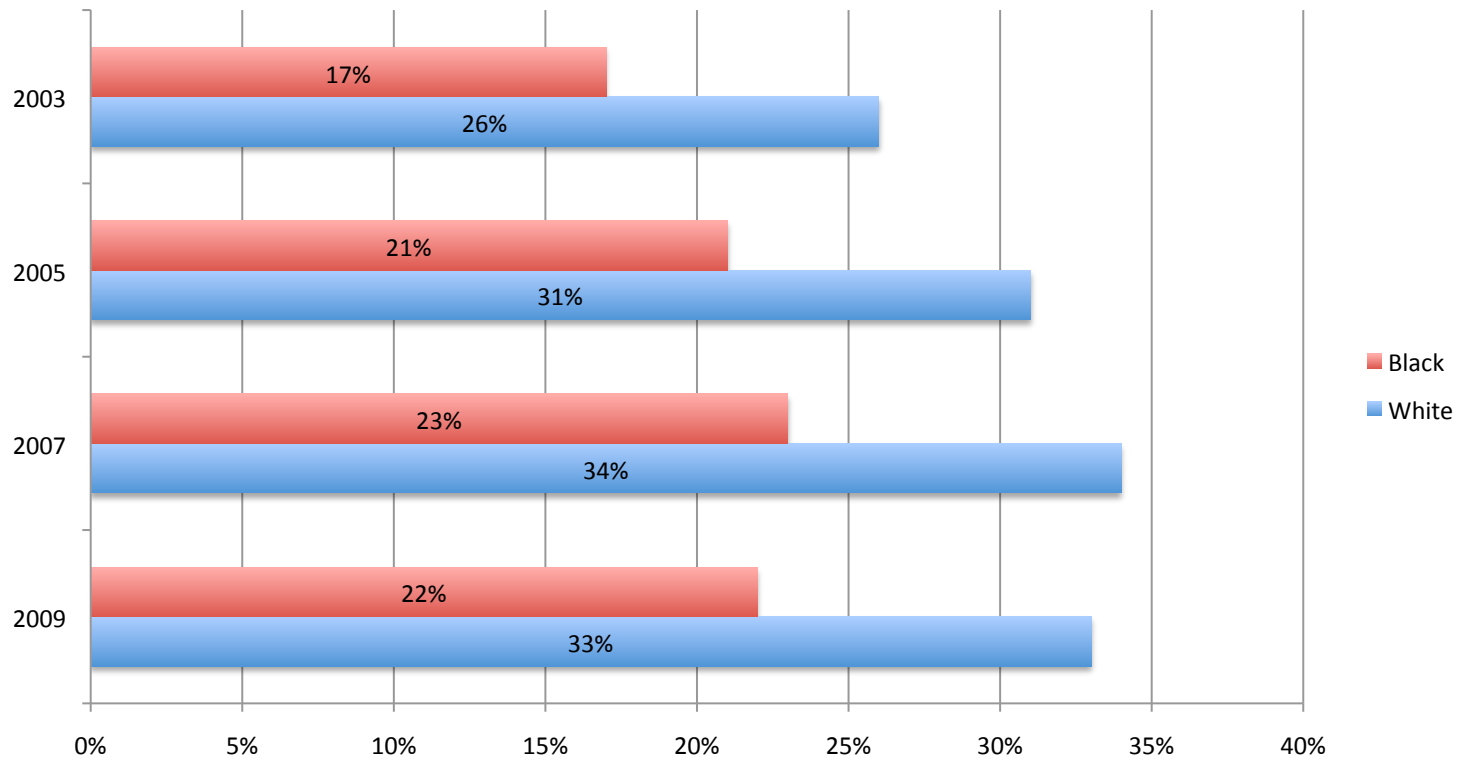
# How Are We Doing in Math

- Only 12 percent of black eighth-grade boys are proficient in math, compared with 44 percent of white boys.
- Poverty alone does not seem to explain the differences: poor white boys do just as well as African-American boys who do not live in poverty, measured by whether they qualify for subsidized school lunches.

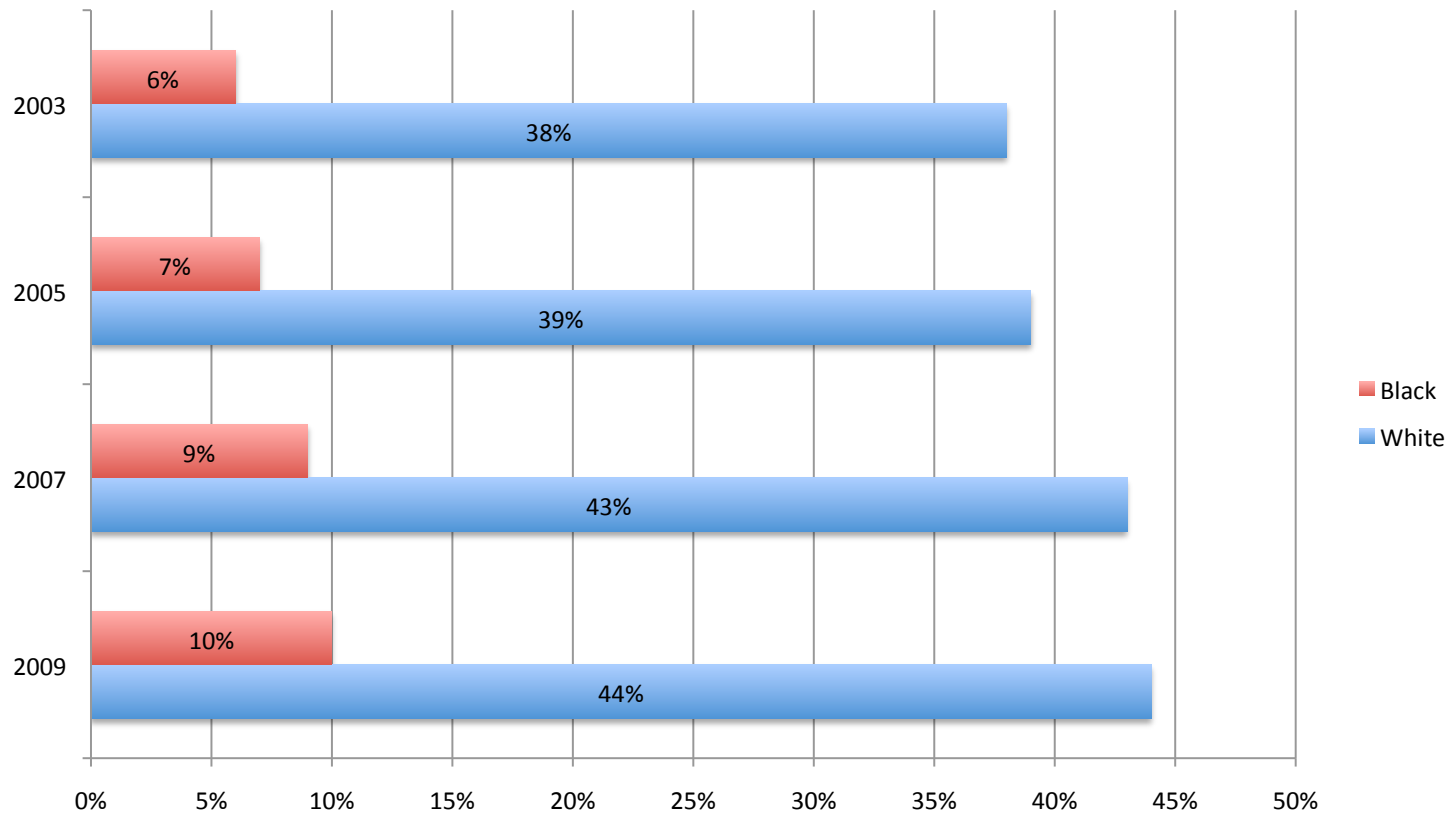
# % of Grade 4 Black Males vs. White Males Performing at or Above Proficient in Math (SD, FRPL)



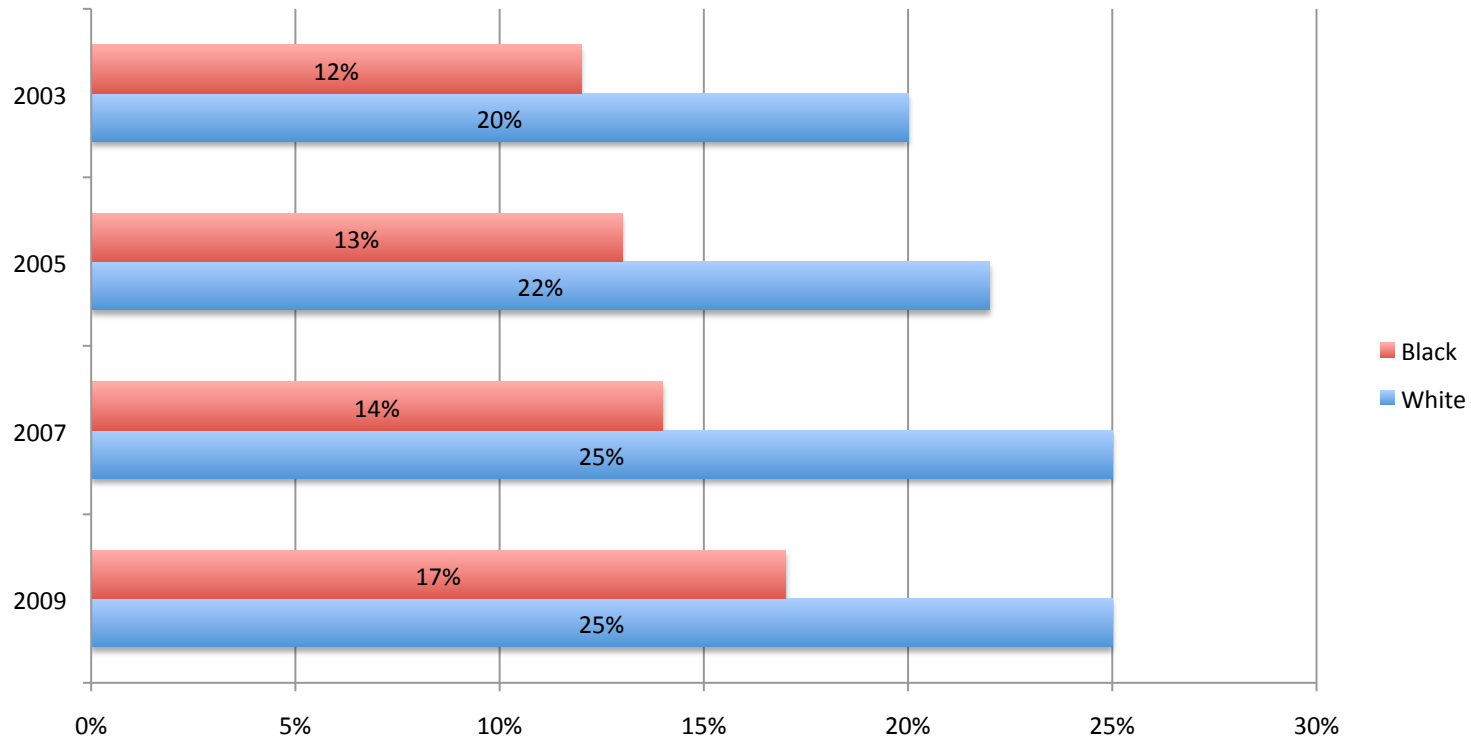
## % of Grade 4 Non-FRPL Black Males vs. White Males Performing at or Above Proficient in Math



# % of Grade 8 Black Males vs. White Males Performing at or Above Proficient in Math (SD, FRPL)



## % of Grade 8 Non-FRPL Black Males vs. White Males Performing at or Above Proficient in Math



# Algebra Gateway not Gatekeeper

- ***Algebra is the "gatekeeper" that lets people into rewarding careers and keeps others out.***
- Algebra is not just for the college-bound. Students headed straight from high school to the work force will need the same math skills as college freshmen.
- ***Algebra is the GATWAY to success in the 21<sup>st</sup> Century.***

