

Deriving Meaning: Math at Work in Rincon High School

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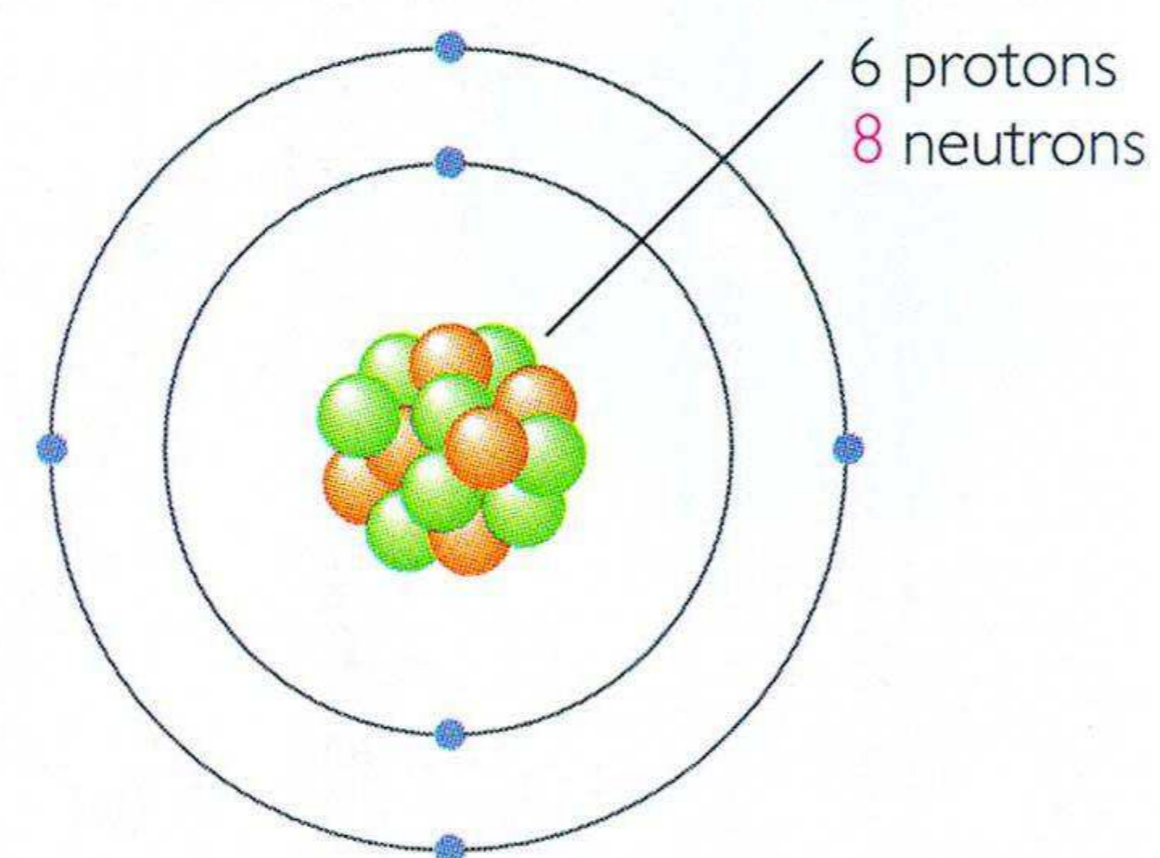
Who are We?

Charles Collingwood: a teacher of 15 years; currently at Rincon High; teaching A.P. Calculus, Pre-calculus, and Stats; a grad student at the U of A.

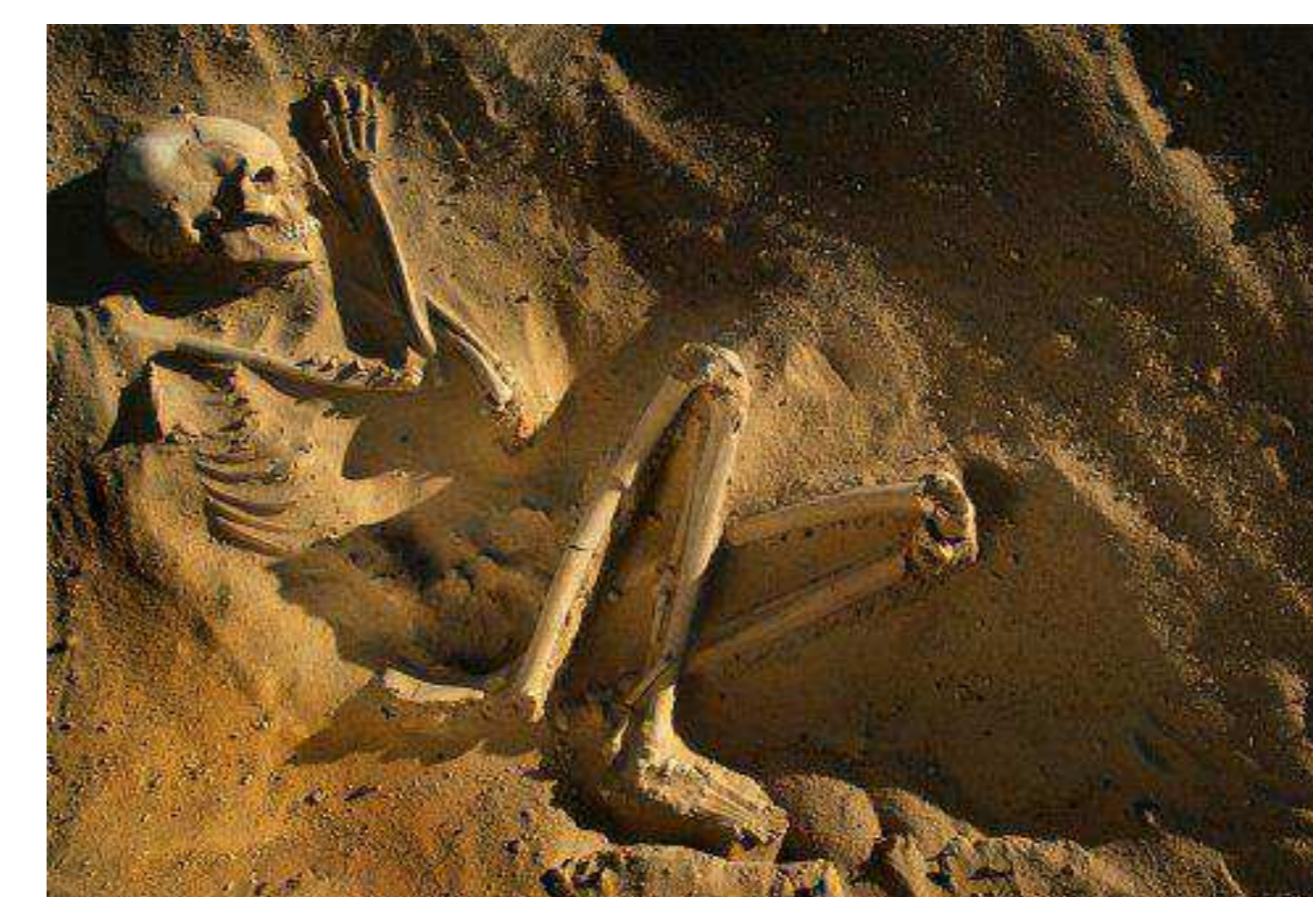
Jordan Schettler: graduated with B.Sc. in math from the Univ. of Tenn.; a Ph.D. student at the U of A; a G-TEAMS fellow working with Charles.

Our Philosophy: Students ONLY learn the mathematical "alphabet" in K-10; we teach them "words" by analyzing functions abstractly and then reinforcing with labs. Carefully written reports are required. The poster shows some of these labs.

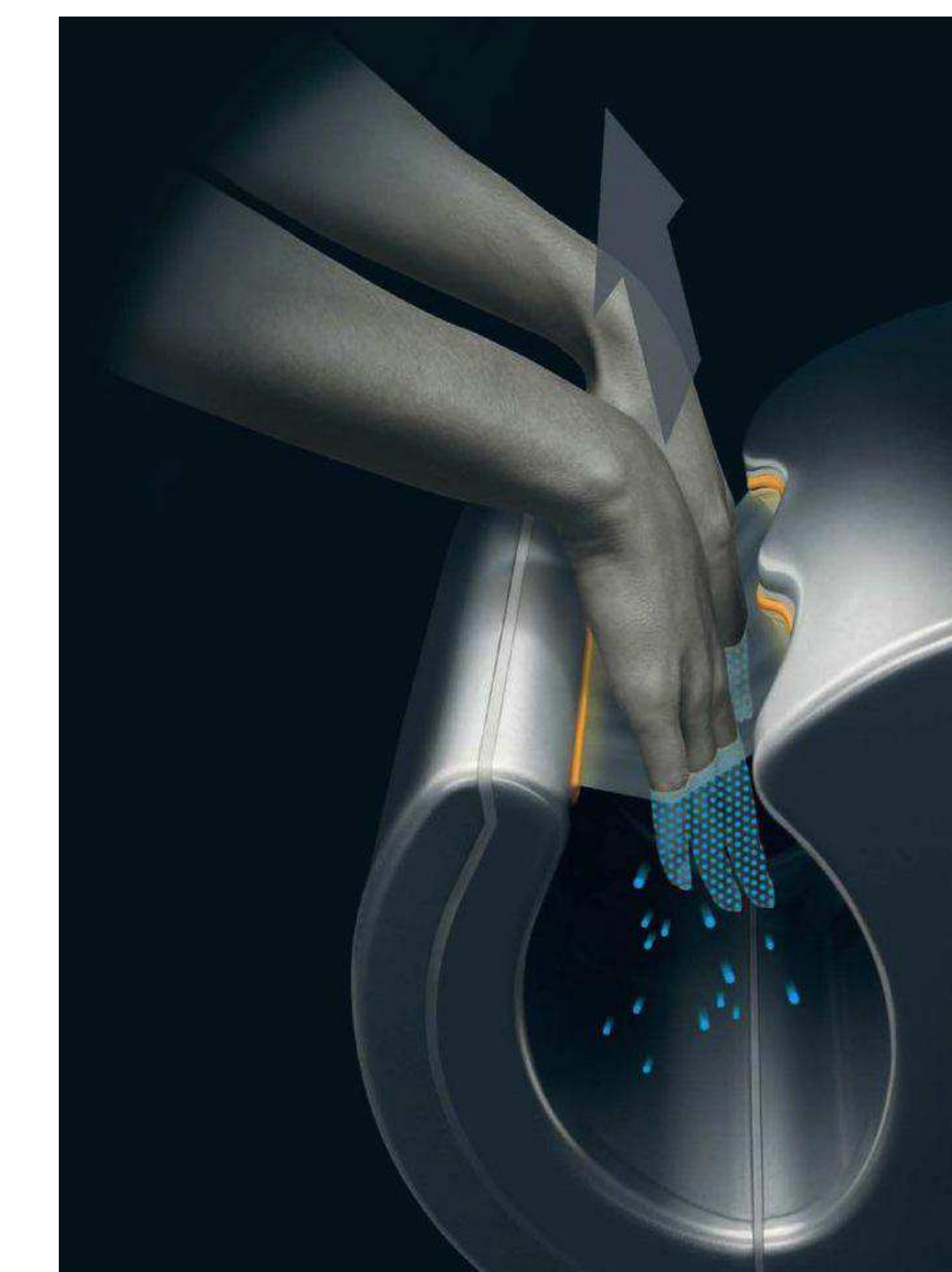
Carbon-14: Exponential Modeling



The element has a half-life $\lambda = 5,730$ years. It's suitable for dating carbon-based life forms. Find decay models $A = Pe^{-rt}$ and $A = P(1/2)^{kt}$. Remains w/ 88% of living ^{14}C were found in 1989. Establish time of death; do inverse problem.

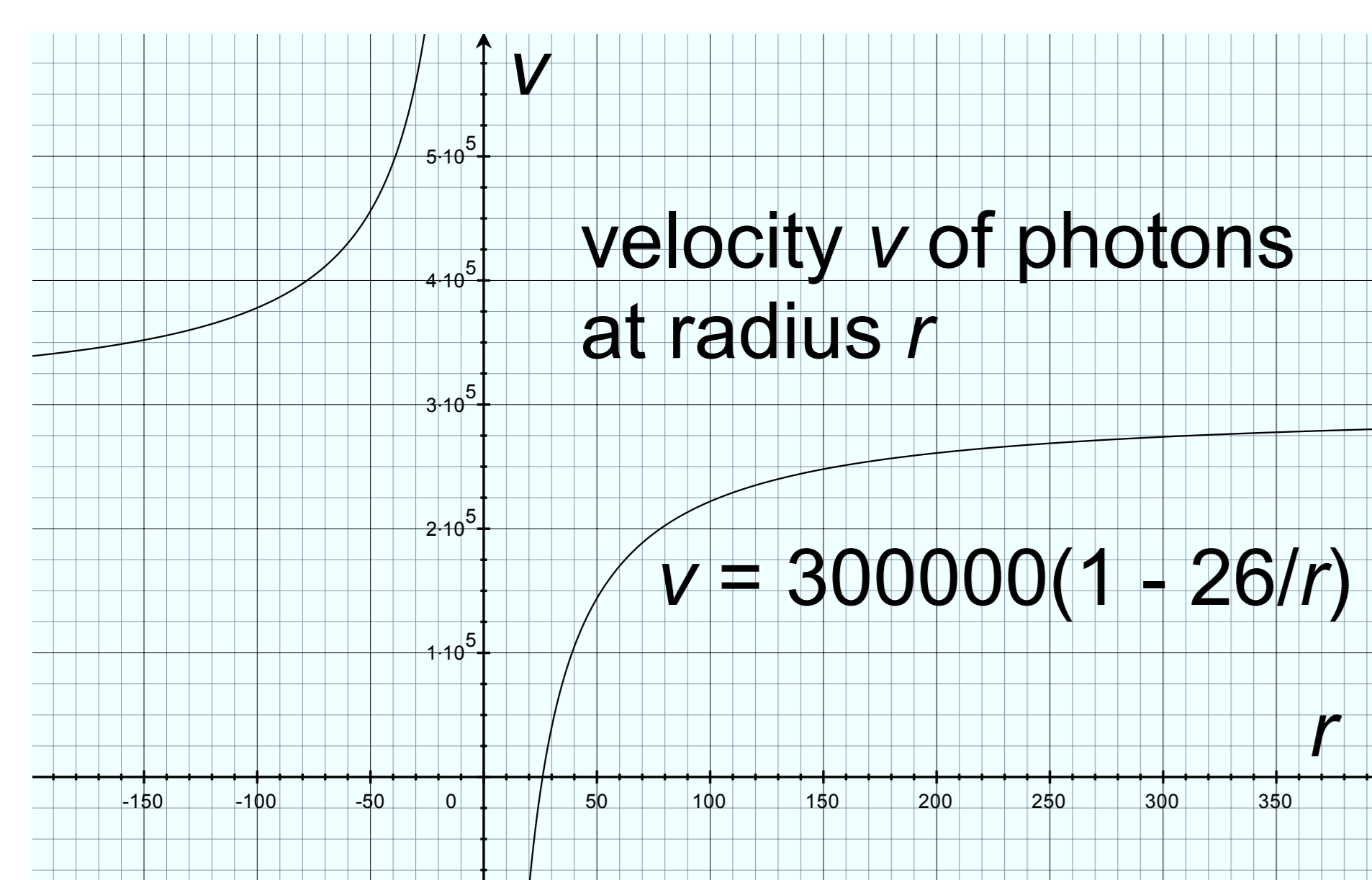
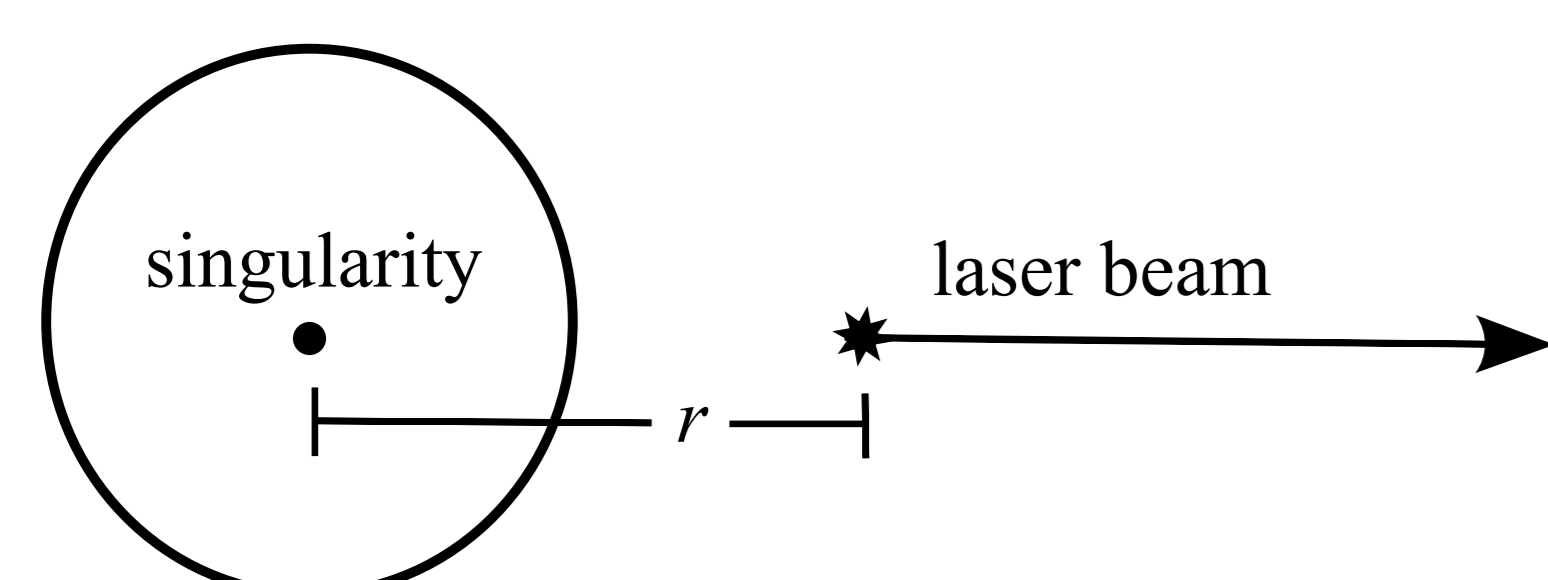
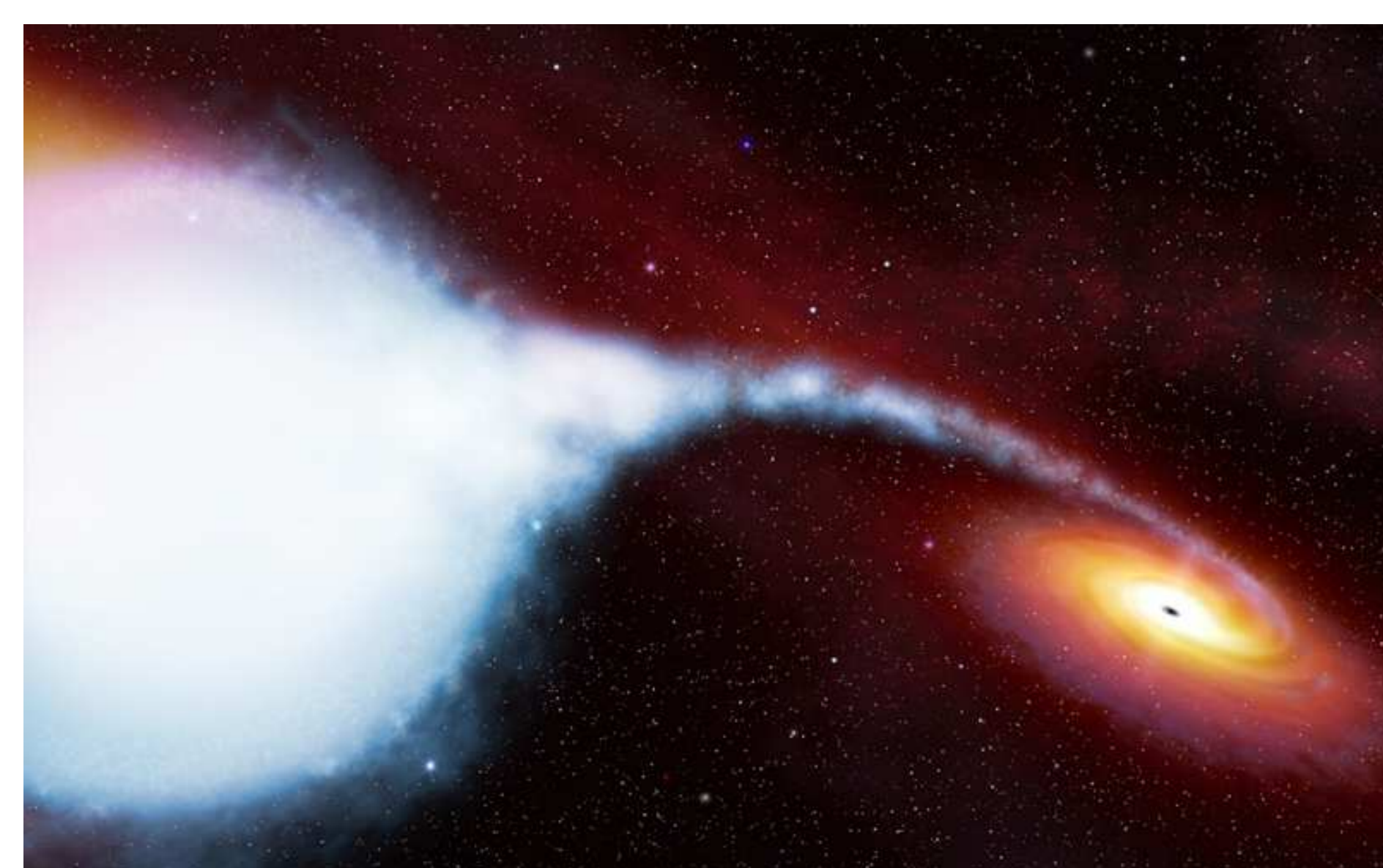


Dyson Airblade: Linear Modeling



Could Rincon get a \$1,200 dollar Dyson AirBlade? Student derived cost models for paper towels vs. the hand dryer. They found and interpreted the intersection point. Some students even factored in energy consumption.

A Black Hole: Rational Functions



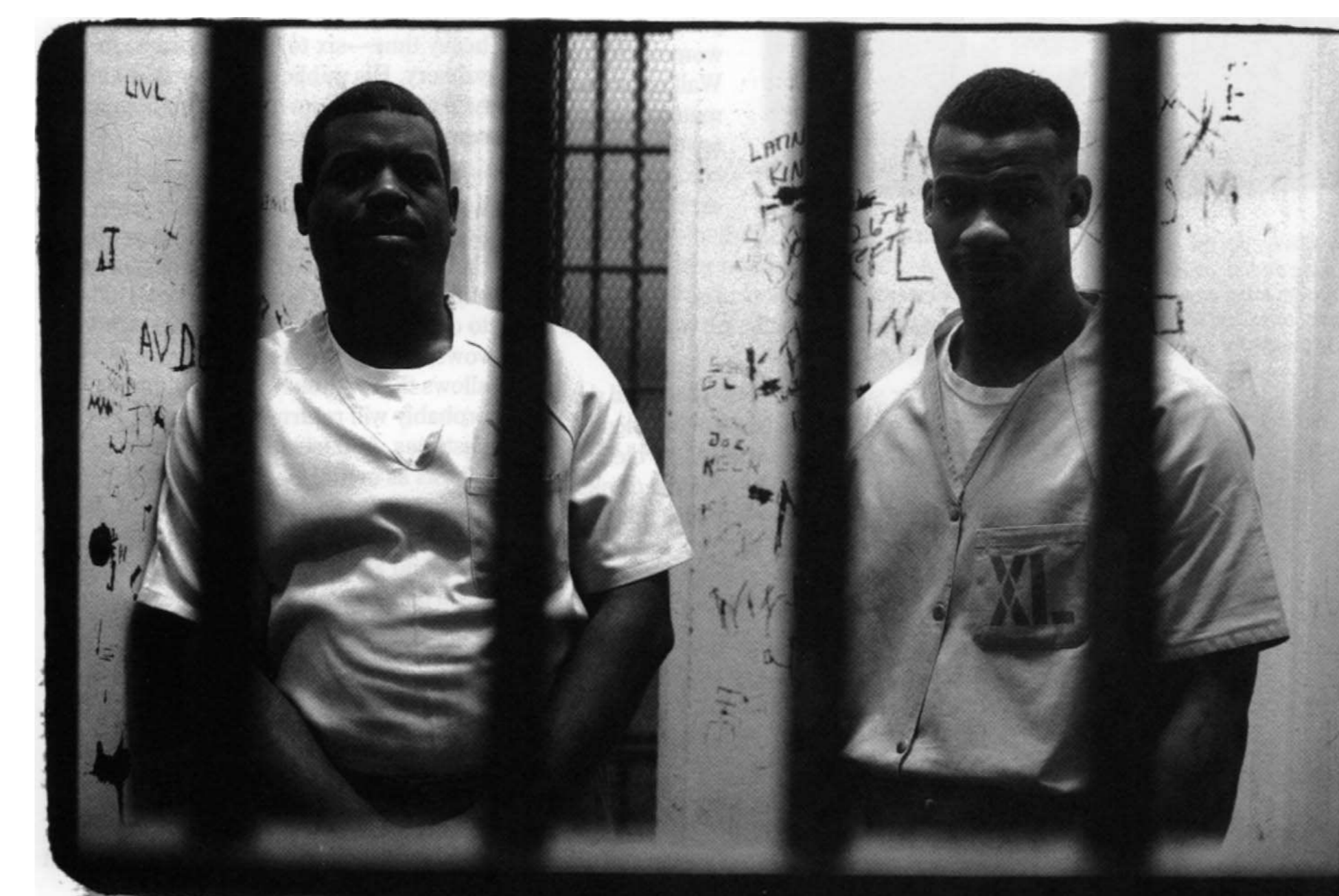
horizontal asymptote \leftrightarrow flat space
 x -intercept \leftrightarrow event horizon
 vertical asymptote \leftrightarrow singularity

Over-Representation: Binomial Distribution

In 2005, black men constituted 12.5% of US men, but 389 out of every 1,000 US male inmates was black.

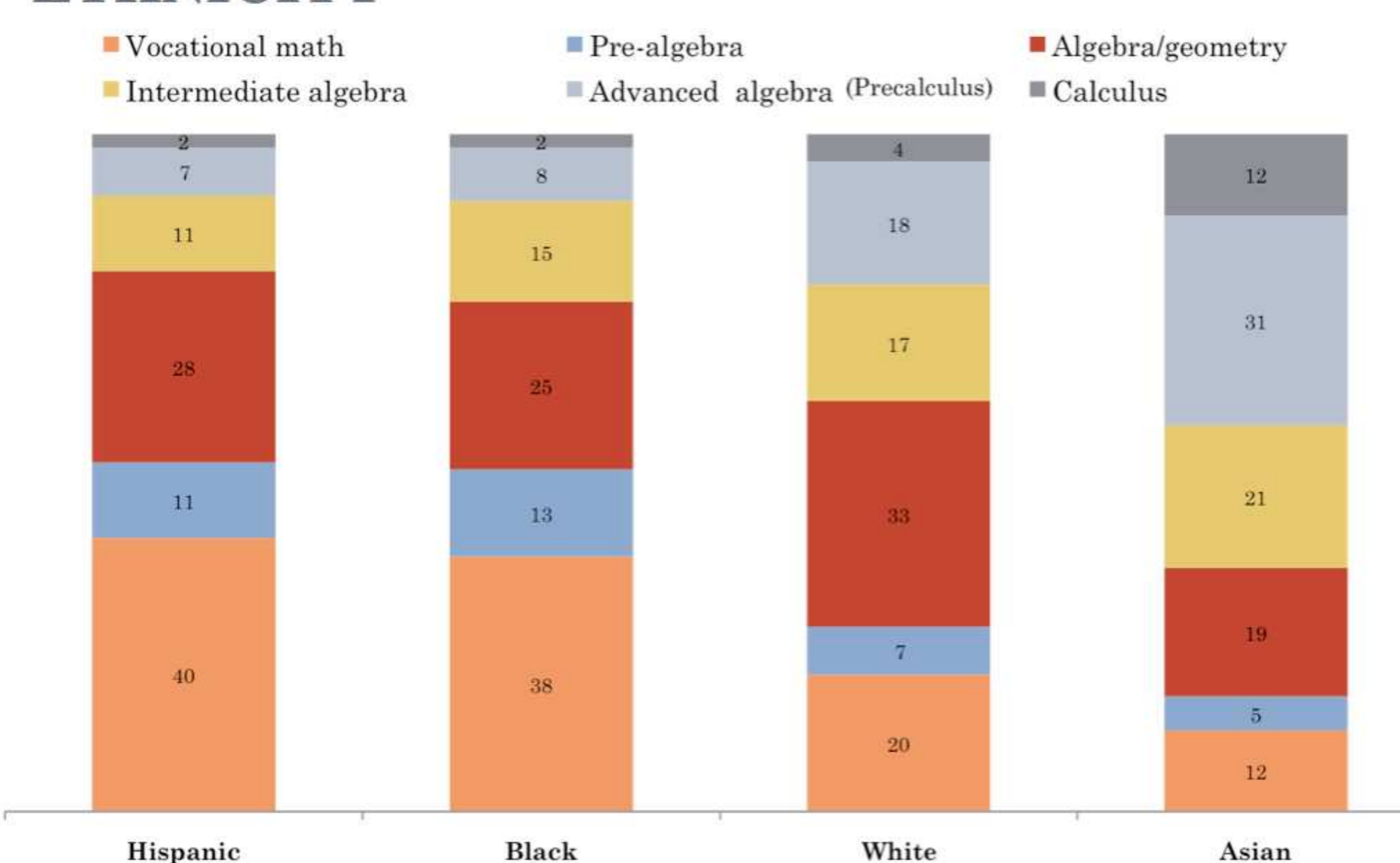
Suppose $p = 0.125$ is the probability of getting a black male in a trial and let $n = 1,000$ be the number of trials. Then the probability of getting more than 388 black males is $P(k \geq 389) \approx 0$.

142 is maximal such that $P(k \geq 142) > 0.05$. This means that we would have expected at most 142 black males out of 1,000 males inmates assuming that being incarcerated was color blind.



Math Achievement and Ethnicity: χ^2 -Independence Test

HIGHEST MATH COURSE TAKEN BY ETHNICITY



What's the story at Rincon?

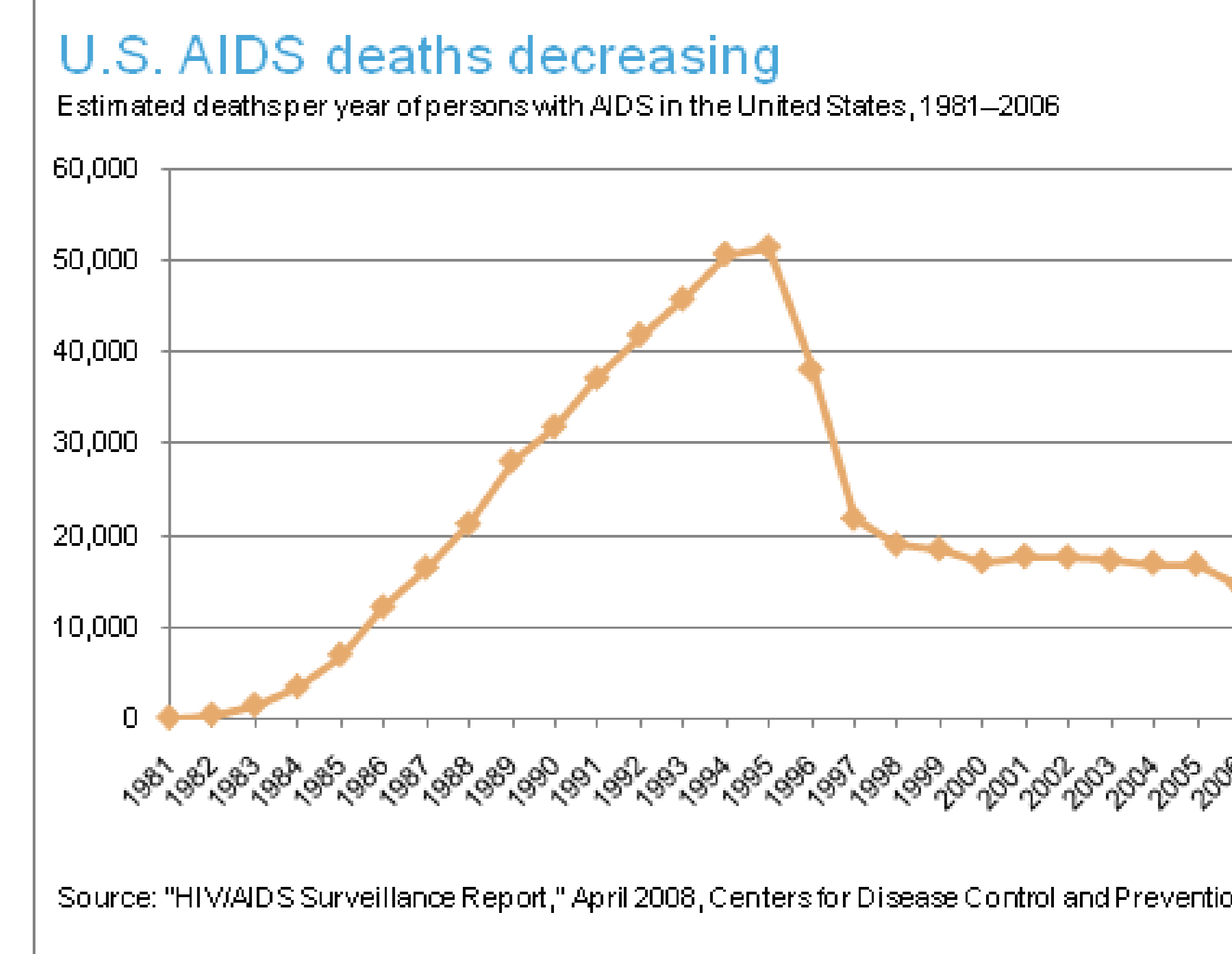
	Hispanic	Black	White	Asian
A	48 (58)	11 (15)	43 (40)	20 (8)
B	73 (79)	14 (21)	65 (55)	14 (11)
C	76 (96)	29 (25)	80 (66)	15 (13)
D	128 (116)	28 (31)	80 (81)	8 (16)
F	199 (175)	56 (46)	96 (122)	16 (25)

Observed vs. (Expected) Grades in Math, 2010

The test statistic is $= 52.83061161\dots$
 The p -value is $\Sigma = 0.00000044152365$.

Assuming a student's grade in math is independent of their ethnicity, the p -value is the probability of getting a test statistic $\geq \Sigma$. Here the p -value is very small, so we should reject the assumption of independence. We also used this data to create frequency tables from each column. Then students computed mean, standard deviation, and histograms for GPA.

AIDS Epidemic: Logistic Growth



US AIDS deaths grew logistically from 81 to 95, so students could find the maximal growth rate and carrying capacity. A single regression will not fit the whole data set, so piecewise models were used.

Students had to explain the impact of antiretroviral drugs, awareness, etc., and also compare/contrast the same data for South Africa.