Modifying “The Spread of the Common Cold”

Adjusting activities to suit your students’ needs

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Spread of the common cold by: Corban Harwood

An excellent adaptable fun activity! Simiode Modeling 1-37-S

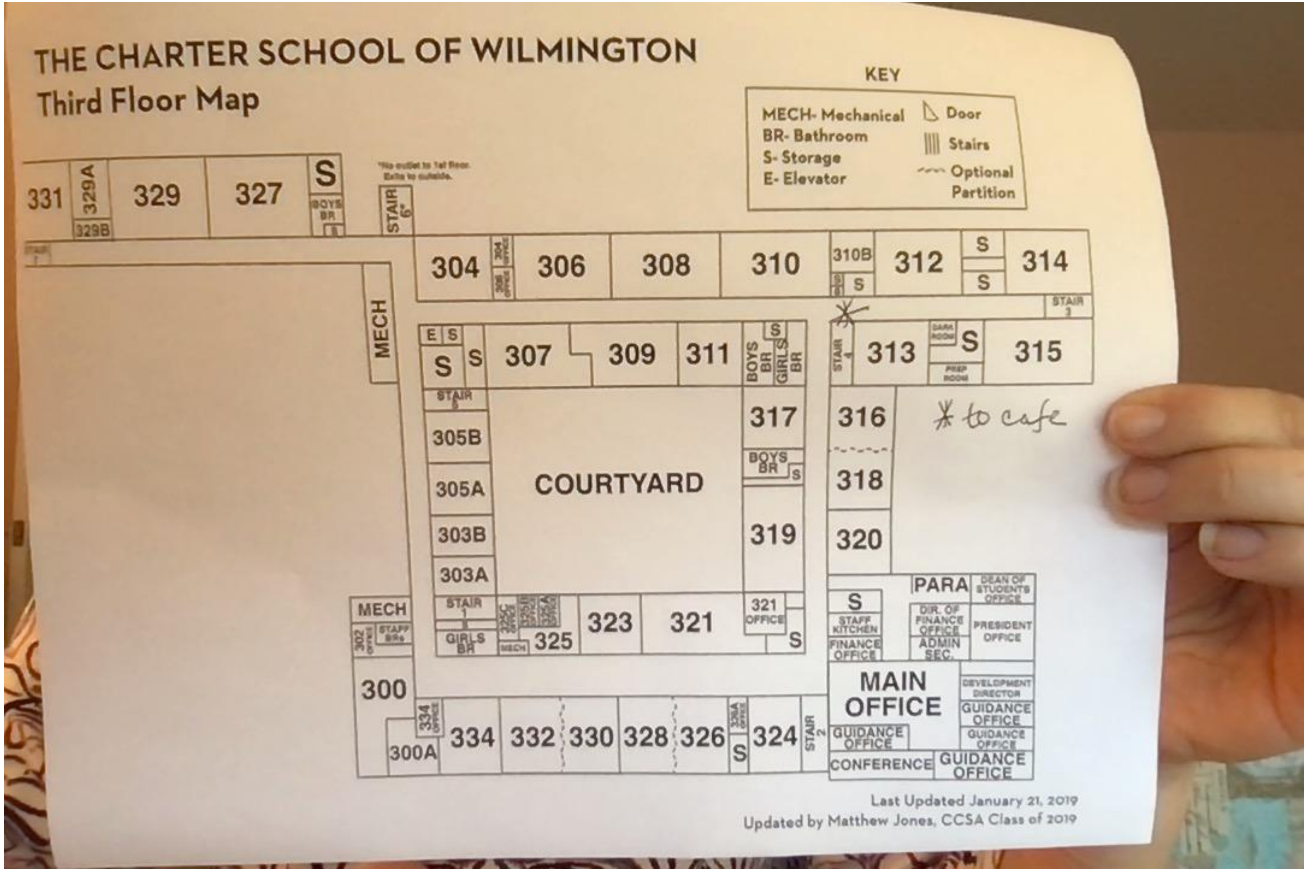
I first used it in a SIMIODE workshop during summer of 2021

Used in pre-calc to teach logistic functions

Used in BC calc to teach solving DEQ with partial fractions and logistic functions

Used in Math Modeling with DEQ in the population models unit this includes solving DEQ's using partial fractions, slope fields, phase plots and bifurcation points.

I replaced the included dorm floor plan with our school floor plan



The Pre-Calc Version

Document

My students in this class often struggle to learn mathematics, so hands on discovery activities are a must. We use desmos a lot and art activities.

Here the focus is on learning about logistic functions and the properties of these functions.

By modeling the spread of a cold through our school floor plan, and some guided questions students are able to discover this function shape including (hopefully) some observations of when the change in the function is greatest .

They also learn about math modeling and compare a regression model to an analytically solved model as well as an “eyeball model”.

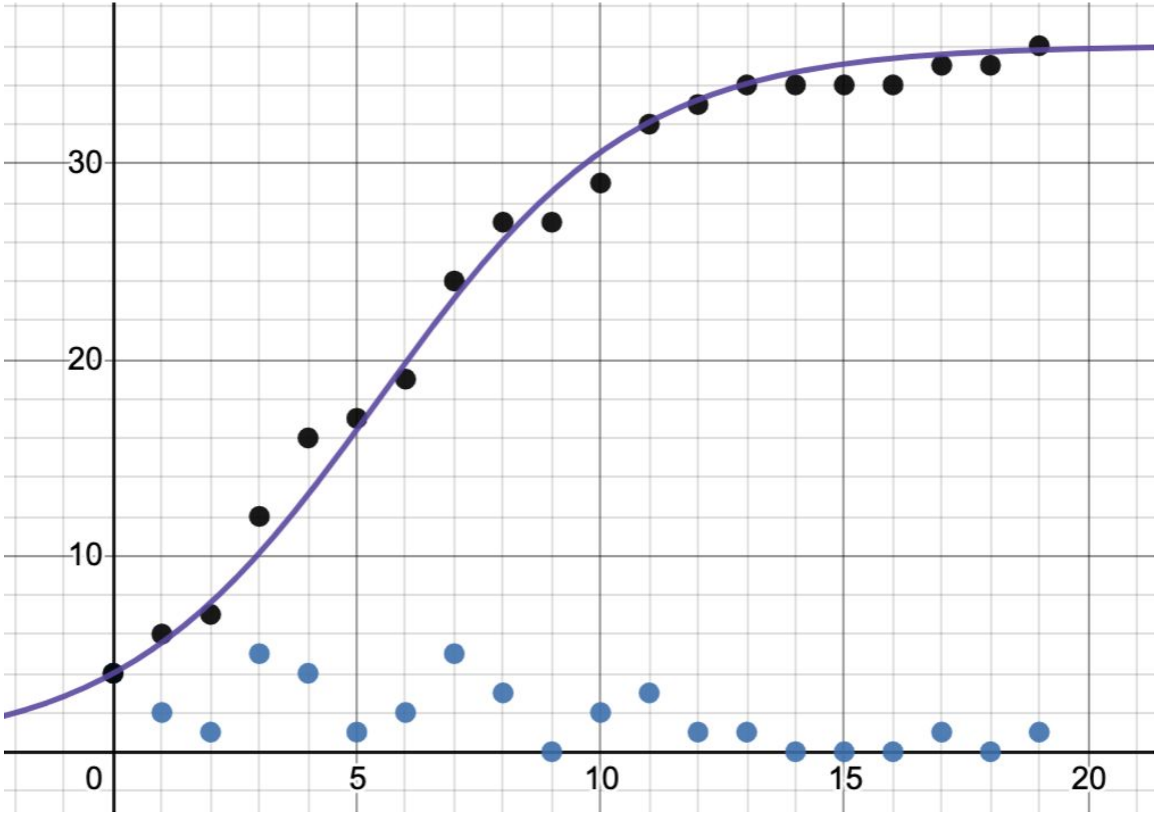
Pre-calc data from Bella and Nate

Black: is y vs t

Blue: is Δy vs t

Purple: desmos regression model

I learned that my attempts to plot Δy vs t to highlight the relationship between the inflection point and the max Δy didn't work. Stick with the average Δy outlined in the original



The BC Calculus Version

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These are my AP students. It is assumed that their teacher can throw anything at them and they will figure it out to regurgitate on the AP exam, but this does a great disservice to them as learners and also to the joy and applications of calculus that we espouse.

Using math modeling throughout the AP course helps students understand, retain and make sense of the calculus. Part1: students run the simulation and gather data. They attempt to create the DEQ with graphs and guided questioning from me. Then we need a technique to solve the DEQ. Afterwards we return to Part 2 to solve for models and see if they fit the data.

Making the adjustment to use our school's floor plan and again adjusting the questioning make it an interesting and fun activity.

My lesson learned: use the average Δy for $\Delta y/dt$ and plot it vs y to make the relationship between inflection point and max $\Delta y/dt$ stand out. The phase plot, even though not part of the BC curriculum, is a better visual to teach the concept and shows where the DEQ comes from in the first place.

BC calc data from Anna

Orange is y vs t, green is Δy vs t

4

$$y_1 \sim mx_1 + b$$

STATISTICS

$r^2 = 0.179$

$r = 0.423$

RESIDUALS

e_2 plot

PARAMETERS

$m = 0.117857$ $b = 1.64167$

5

$$y = \frac{37}{1 + 11.3e^{-0.35x}}$$

6

$$y_2 \sim \frac{L}{1 + be^{-kx_1}}$$

STATISTICS

$R^2 = 0.9843$

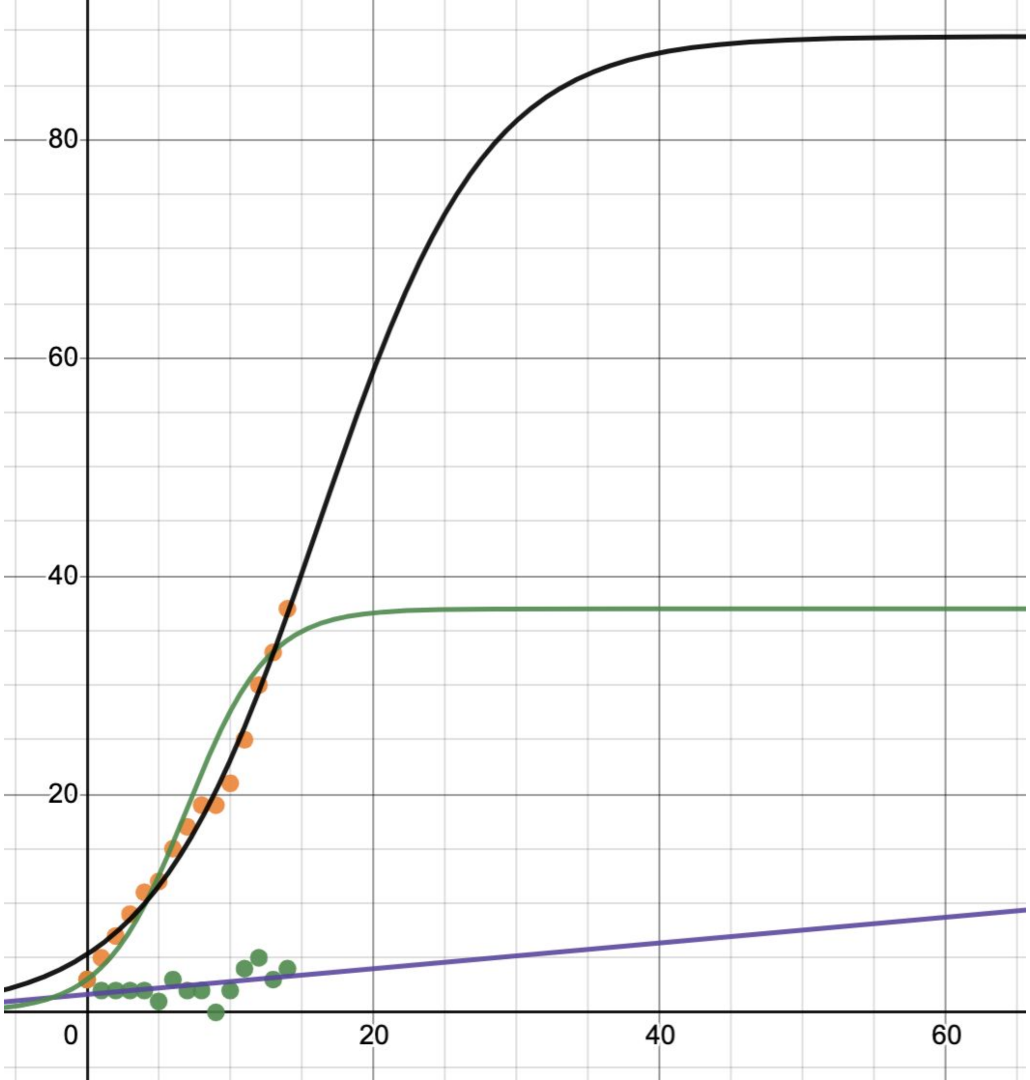
RESIDUALS

e_4

PARAMETERS

$L = 89.4798$ $b = 15.8195$

$k = 0.170593$



The Math Modeling w/DEQ

Use Student Version:Simulating the spread of the common cold by Corban Harwood Simiode Scenario 1-37-S

These students are my post AP students. I taught them BC Calculus and Calculus 3. They are interested in learning about Differential Equations, but simply pushing around symbols doesn’t teach problem solving techniques or motivate their existence.

My focus here is on developing the model for the differential equation so,I use the SIMIODE original. If needed, I supplement with the questioning from the BC version.

Also shows visually the relationship between the generic differential equation dy/dt = ky(1-y/L) and the solution y(t) = L / (1+be^(-kt))

Revisit the partial fraction technique.

Vocabulary: phase line portrait, phase portrait, autonomous, stability point, bifurcations

DEQ data Zev and Jack

Green: y vs t

Blue: Δy/dt vs y

2

$$y_1 \sim \frac{48}{1 + be^{-kx_1}}$$

STATISTICS

$R^2 = 0.9986$

RESIDUALS

e_2 plot

PARAMETERS

$b = 37.223$ $k = 0.548702$

3

$$y_3 \sim kx_3\left(1 - \frac{x_3}{48}\right)$$

STATISTICS

$R^2 = 0.767$

RESIDUALS

e_3 plot

PARAMETERS

$k = 0.526767$