Computational Share-a-Thon

The American Association of Physics Teachers urges that every physics and astronomy department provide its majors and potential majors with appropriate instruction in computational physics.

(from AAPT Statement on Computational Physics)

AAPT Recommendations for Computational Physics

Partnership for Integrating Computation in Undergraduate Physics (PICUP)

Spreadsheet Calculations to Elucidate Integration

Alex M. Barr
Howard Community College

Goal: To understand integrals as a tool for summing a large number of very tiny contributions

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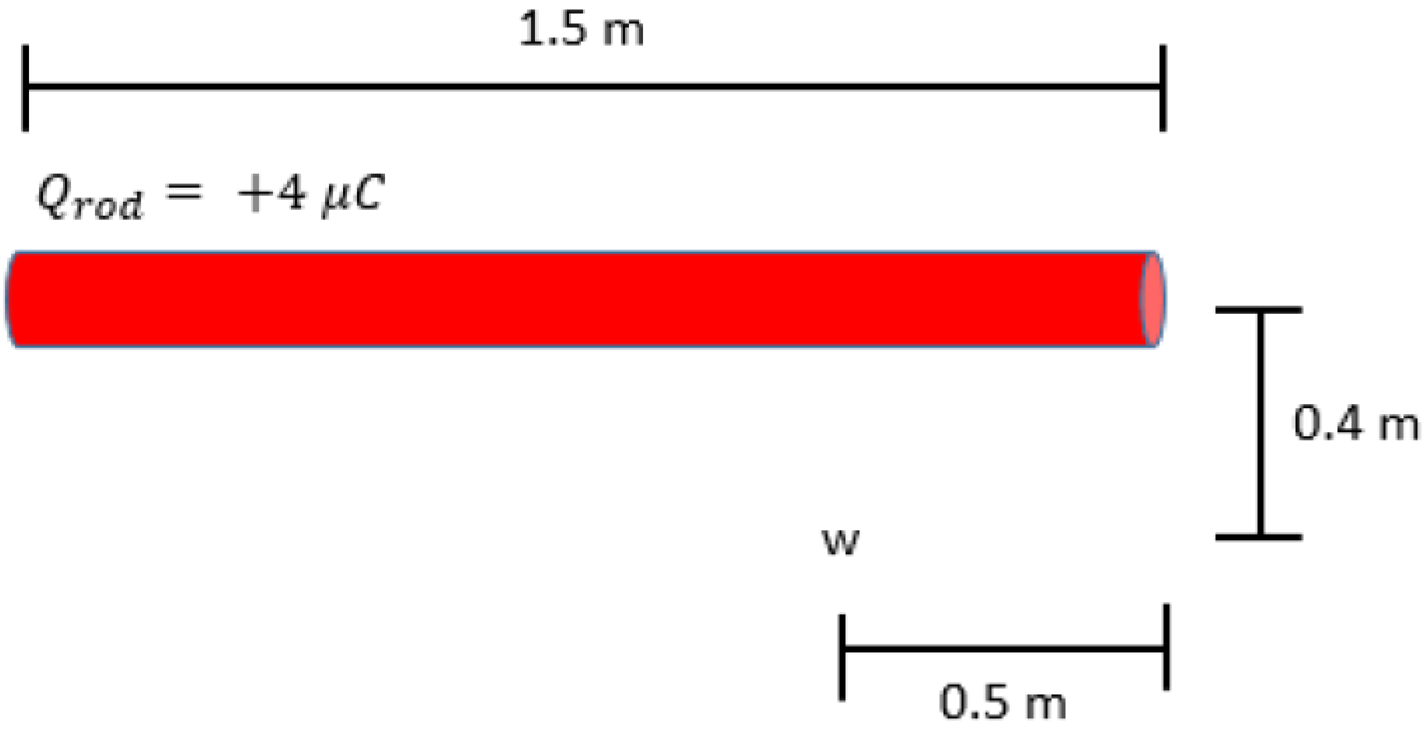
Uniformly charged rod

$$\vec{E} = \int_0^L k \frac{dq}{\bar{r}^2}\,\hat{\bar{r}}$$

Many identical point charges

$$\vec{E} = \sum_{i=1}^{N} k \frac{q_i}{r_i^2}\,\widehat{r_i}$$

Task: Calculate the electric field of a uniformly charged rod at point w.



Do the calculation 3 times treating the rod as 100 charges, 500 charges, and finally 1,000 charges.

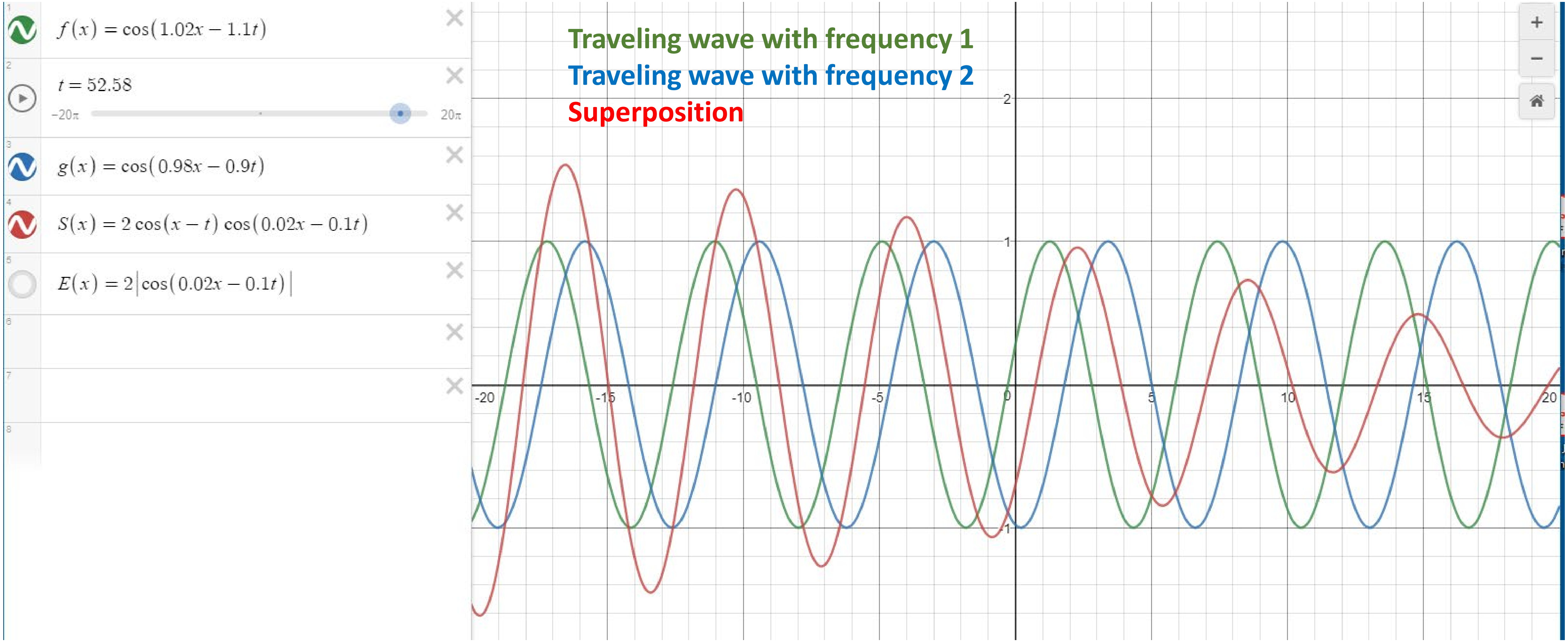
Spreadsheet Calculations:
https://docs.google.com/spreadsheets/d/1piiqRNuE9tg2lhQPxF1cnd_DZANU5on_gAkB4Vx3VRo/edit?usp=sharing

Instructions to Students:
https://docs.google.com/document/d/1JAK9tgfFxxw44gNw7cASDSnQszfWfCDFMSdzZGggKAg/edit?usp=sharing

Using Desmos to Illustrate Phase Velocity vs. Group Velocity

Carl Mungan
US Naval Academy

Desmos: A free online graphing tool that can also animate graphs, https://www.desmos.com/calculator/8ydtnvn5tb



1 $f(x) = \cos(1.02x - 1.1t)$

2 $t = 52.58$

-20π 20π

3 $g(x) = \cos(0.98x - 0.9t)$

4 $S(x) = 2\cos(x - t)\cos(0.02x - 0.1t)$

5 $E(x) = 2\left|\cos(0.02x - 0.1t)\right|$

6

7

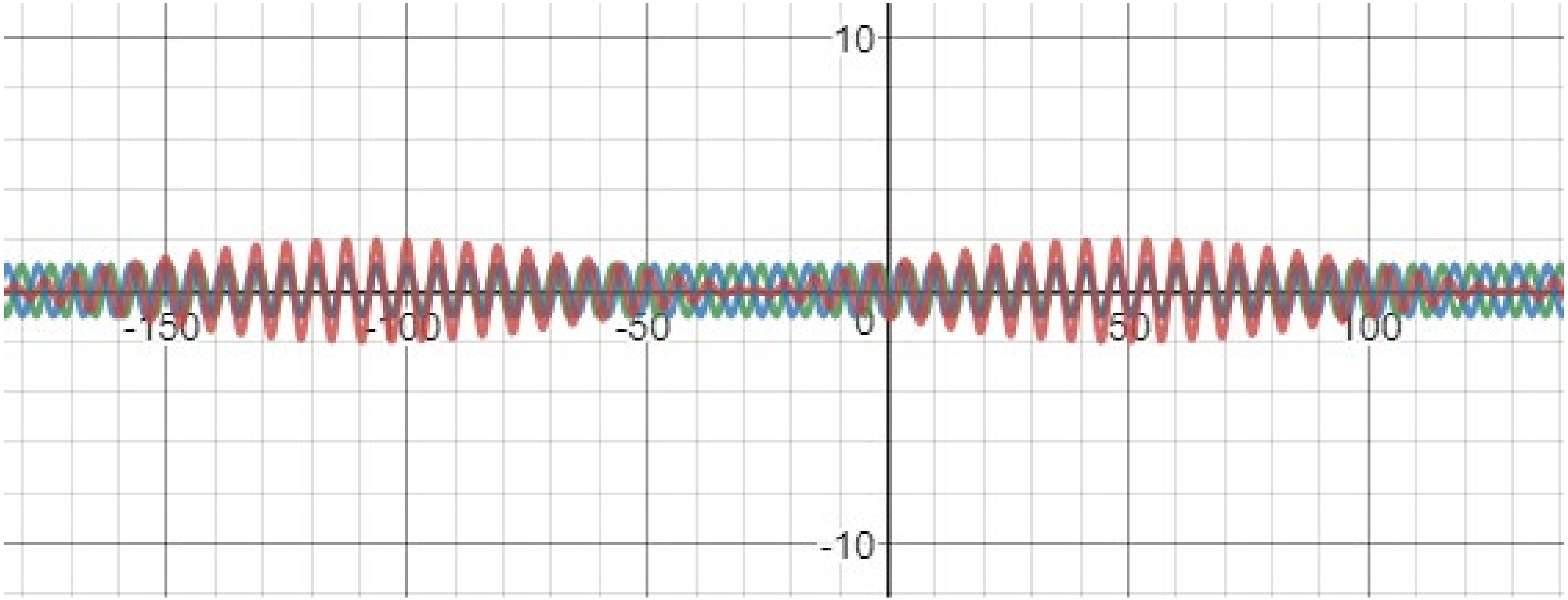
8

Traveling wave with frequency 1

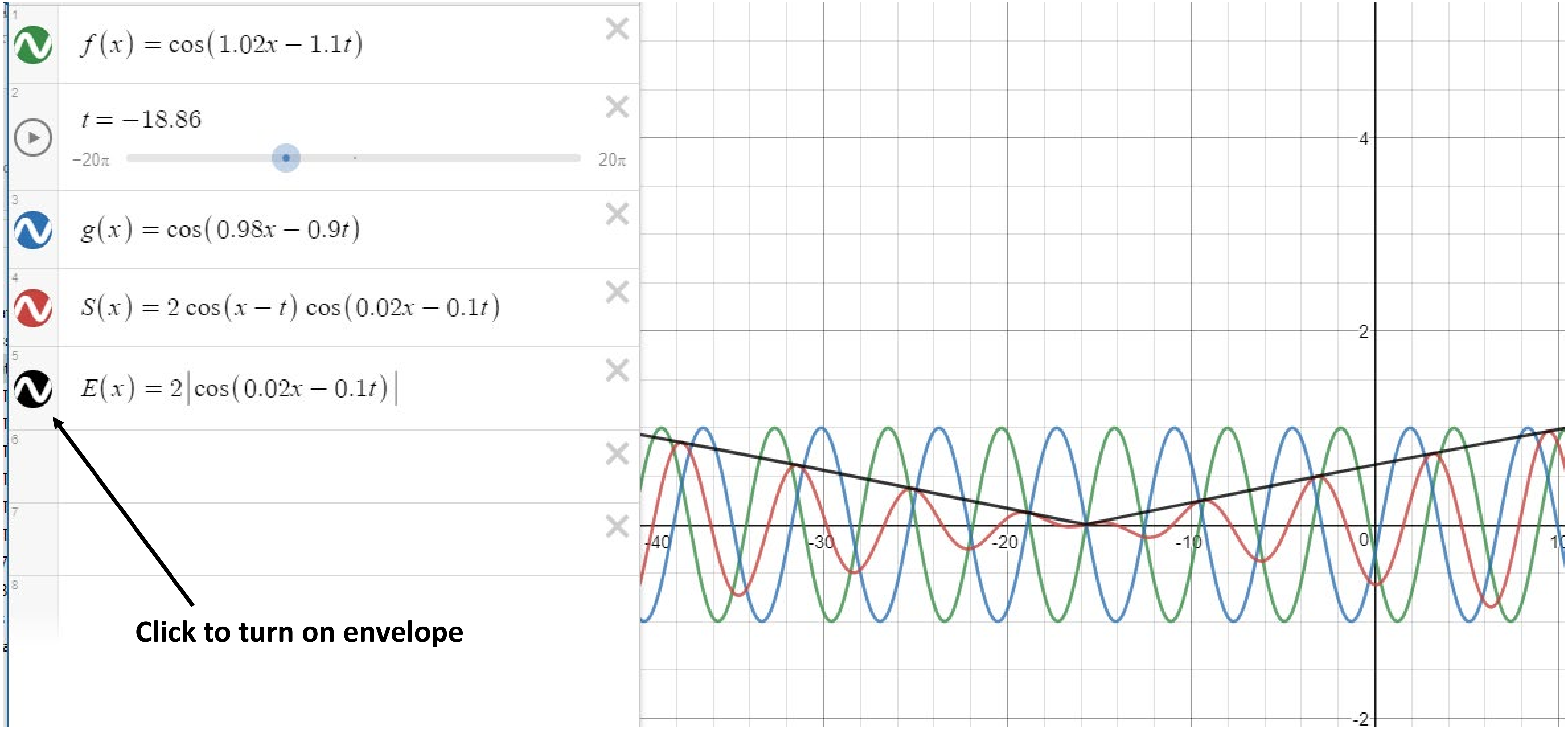
Traveling wave with frequency 2

Superposition

Zooming out we see beats



Can use animated graph to measure speed of red and blue waves and compare to speed of envelope.



$f(x) = \cos(1.02x - 1.1t)$

$t = -18.86$

-20π 20π

$g(x) = \cos(0.98x - 0.9t)$

$S(x) = 2\cos(x - t)\cos(0.02x - 0.1t)$

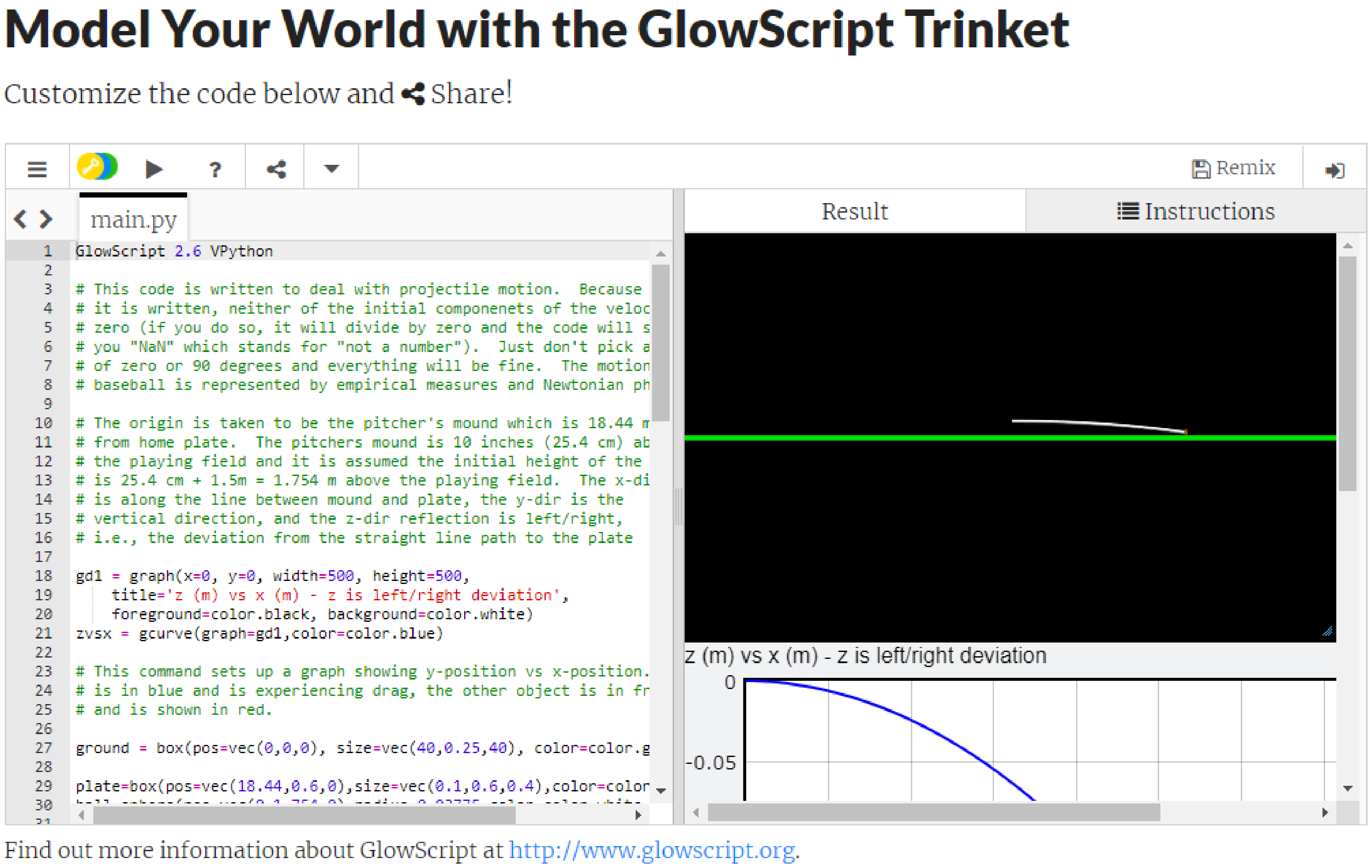
$E(x) = 2\left|\cos(0.02x - 0.1t)\right|$

Click to turn on envelope

Modeling a Curveball using Trinket

Brett Taylor
Radcliff University

Trinket: A free online environment for writing VPython programs, https://trinket.io/glowscript/e5804950bd



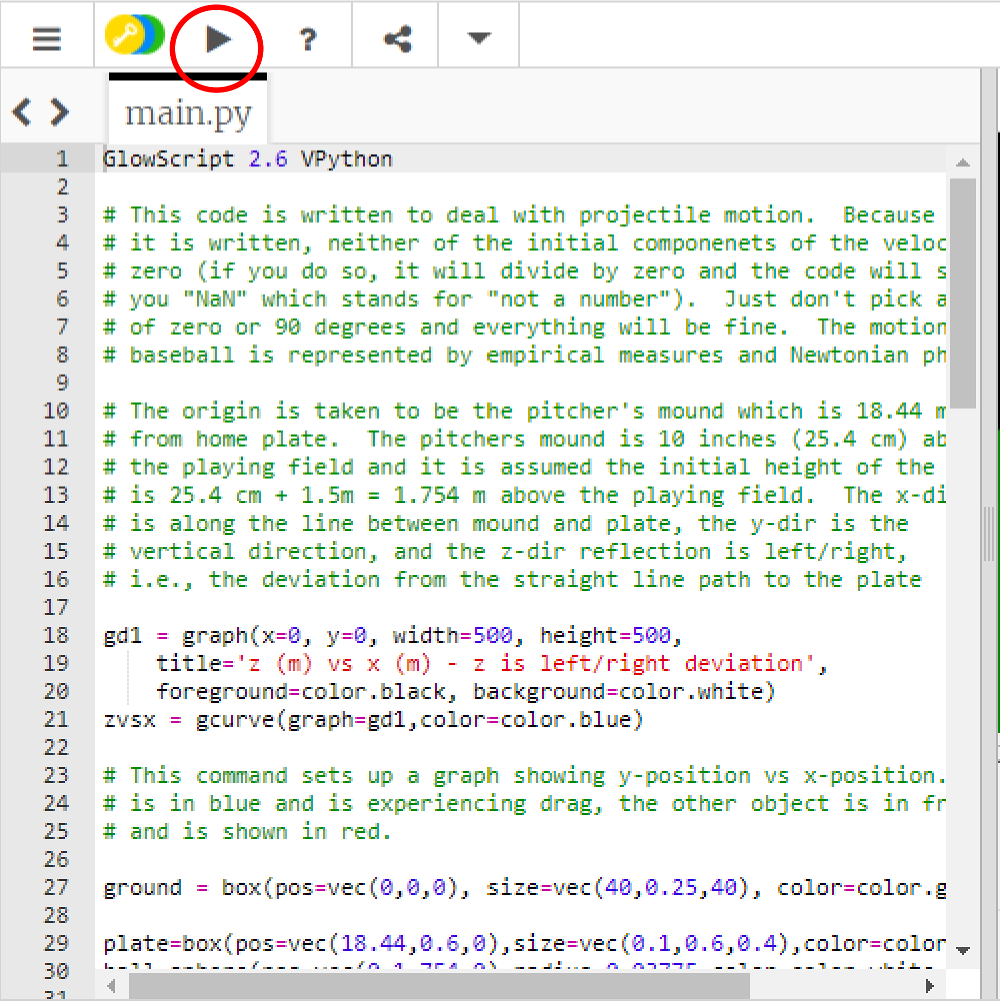
Model Your World with the GlowScript Trinket

Customize the code below and Share!

```
GlowScript 2.6 VPython

# This code is written to deal with projectile motion.  Because
# it is written, neither of the initial componenets of the veloc
# zero (if you do so, it will divide by zero and the code will s
# you "NaN" which stands for "not a number").  Just don't pick a
# of zero or 90 degrees and everything will be fine.  The motion
# baseball is represented by empirical measures and Newtonian ph

# The origin is taken to be the pitcher's mound which is 18.44 m
# from home plate.  The pitchers mound is 10 inches (25.4 cm) ab
# the playing field and it is assumed the initial height of the
# is 25.4 cm + 1.5m = 1.754 m above the playing field.  The x-di
# is along the line between mound and plate, the y-dir is the
# vertical direction, and the z-dir reflection is left/right,
# i.e., the deviation from the straight line path to the plate

gd1 = graph(x=0, y=0, width=500, height=500,
    title='z (m) vs x (m) - z is left/right deviation',
    foreground=color.black, background=color.white)
zvsx = gcurve(graph=gd1,color=color.blue)

# This command sets up a graph showing y-position vs x-position.
# is in blue and is experiencing drag, the other object is in fr
# and is shown in red.

ground = box(pos=vec(0,0,0), size=vec(40,0.25,40), color=color.g

plate=box(pos=vec(18.44,0.6,0),size=vec(0.1,0.6,0.4),color=color
ball=sphere(pos=vec(0,1.754,0),radius=0.03775,color=color.white
```

Find out more information about GlowScript at http://www.glowscript.org.

Can provide students a complete or nearly complete set of code on the left which they can modify and click run see the results on the right.



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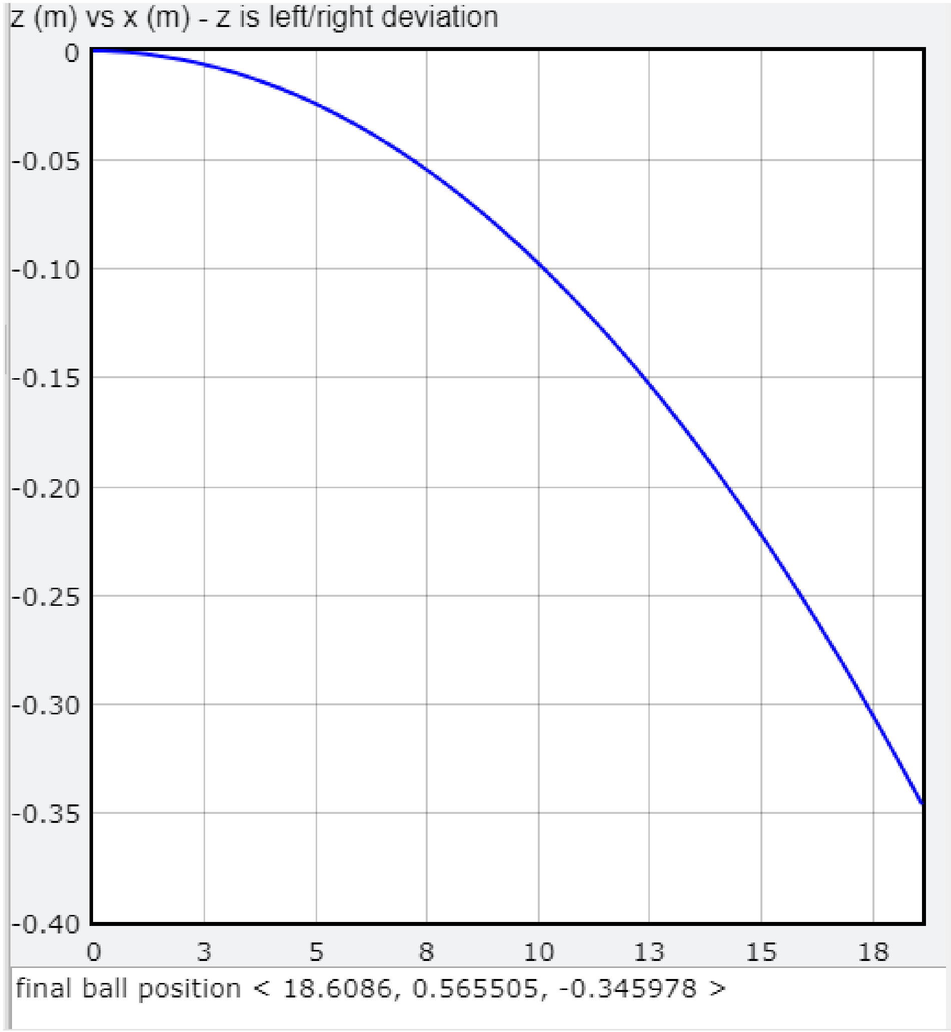
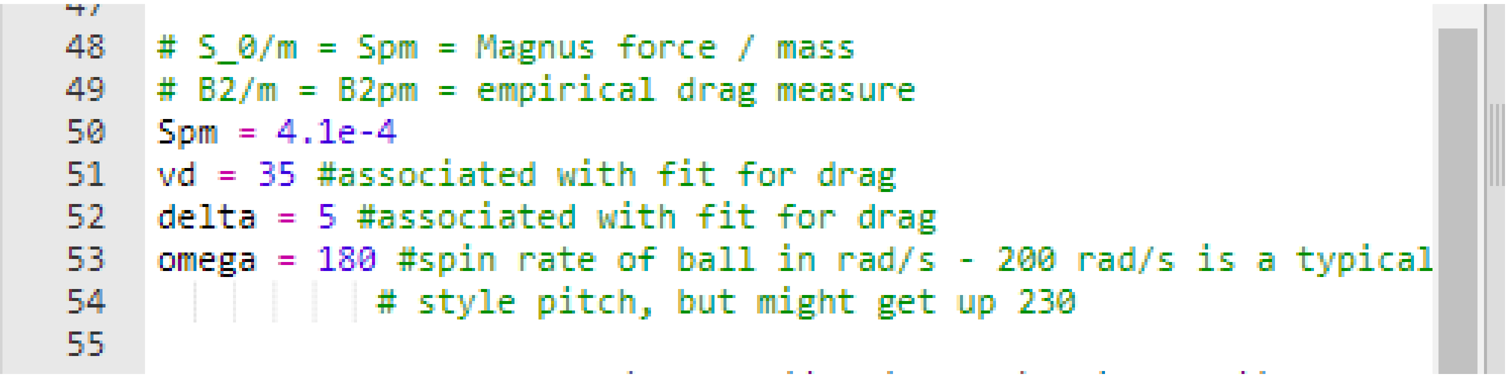
ball=sphere(pos=vec(0,1.754,0),radius=0.03775,color=color.white
```

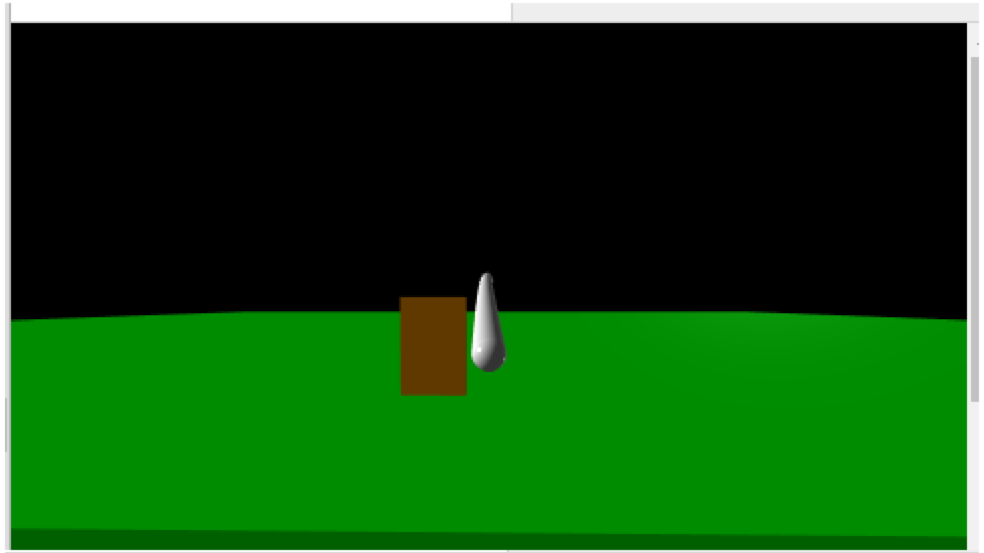


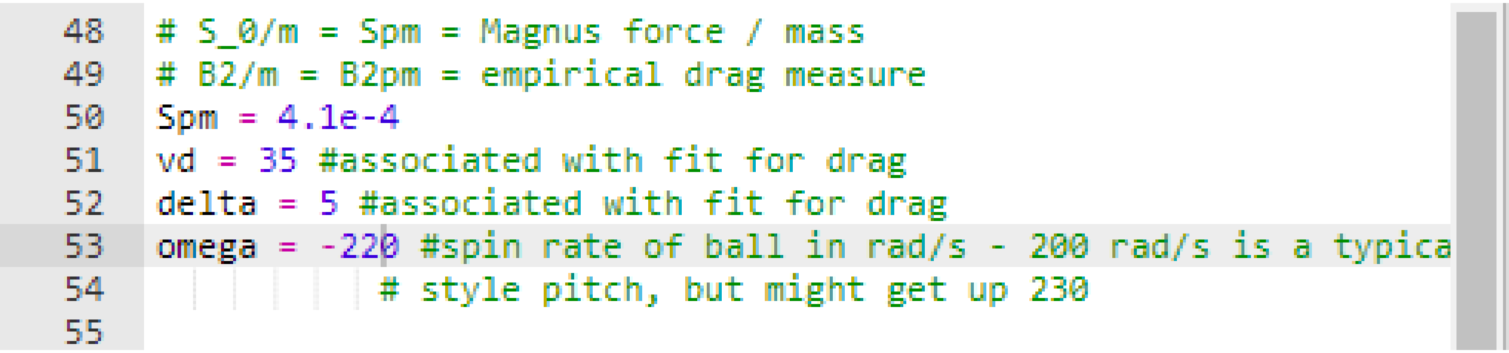
```
final ball position < 18.6086, 0.565505, -0.345978 >
```

Visualization is 3D. Right click to change viewing angle and scroll to zoom. Change omega to see ball curve relative to strike zone.



```
# S_0/m = Spm = Magnus force / mass
# B2/m = B2pm = empirical drag measure
Spm = 4.1e-4
vd = 35 #associated with fit for drag
delta = 5 #associated with fit for drag
omega = 180 #spin rate of ball in rad/s - 200 rad/s is a typical
           # style pitch, but might get up 230
```





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# B2/m = B2pm = empirical drag measure
Spm = 4.1e-4
vd = 35 #associated with fit for drag
delta = 5 #associated with fit for drag
omega = -220 #spin rate of ball in rad/s - 200 rad/s is a typica
           # style pitch, but might get up 230
```

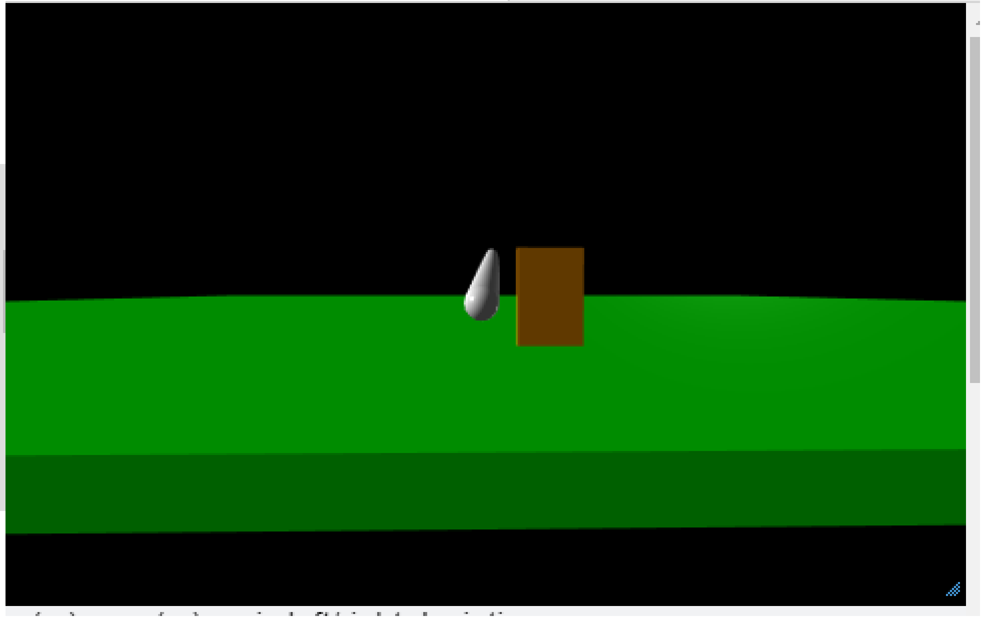

Students can modify the code, save the program as their own, and email instructor the link to their code.

Allows students to explore velocity dependent drag and Magnus force, topics usually too advanced to be studied analytically in first year physics.

Students can modify code to answer their own questions. Ex) Would a penny falling from the Sears Tower be traveling fast enough to cause serious harm?