Katherine Aho
NSF GK-12 Vibes and Waves in Action
Honors Physics Period 10
Lesson 8: R Review for Honors Physics Period 10

Summary of Lesson

This program served as a review for the Honors Period 10 class, since they were ahead of the other classes. We gave them this simple program to write while we waited for the other classes to catch up. This gave them an opportunity to practice or review and R concepts they may have had difficulty with. The physics concept presented in this program was a spring-mass system. They were asked to calculate and plot the force required to move a spring with three different spring constants. A new plotting command to set up a plot legend, was introduced.

Honors Physics Lesson Plan

Text: Conceptual Physics, Paul G. Hewitt
Chapter: Ch 25, Vibrations and Waves
Objectives: Write a program in R to simulate a spring-mass system
Essential Question: How is force related to distance in a spring-mass system?
Frameworks: Waves- 4.1; SIS1, SIS2, SIS3, SIS4

L-Side Activities: Teacher	R-Side Notes: Students
At the Bell: Demonstrate how a spring-mass system works **Agenda:** 1. Explain the legend() command 2. Spring-mass program **Working It Out:** 1. How do you create a plot legend R? 2. How does the spring constant relate to the force? **Class Activity:** Write the code to solve for the spring-mass system. Plot force vs distance. Explain how the spring constant relates to the force. **Homework:** None	I. Spring constant is linearly related to the force

```
# R REVIEW PROGRAM FOR PHYSICS SOLUTION
#
# PHYSICS CONCEPT: SPRING-MASS SYSTEM
# COMPUTE THE FORCE NEEDED TO MOVE THE MASS 0.5 METERS
# SPRING STIFFNESS VARYING (5,10,15 NEWTONS/METER)
#
# EQUATION: F=kx, F: FORCE, k: SPRING STIFFNESS, x: DISTANCE
#
# PROGRAMMING CONCPETS: SEQUENCE OF NUMBERS, ONE-DIMENSIONAL ARRAY
# CALCULATE AN EQUATION, PLOTTING WITH LABELS AND LEGEND
#
# WRITTEN BY: KATHERINE AHO
# NSF GK-12 FELLOWSHIP
############################################################

# CREATING THE SEQUENCE FOR DISTANCE
x <- seq(0,0.5,0.001)    # PICK A SMALL ENOUGH INCREMENT TO GET ENOUGH DATA

# CREATING THE ARRAY OF DIFFERENT SPRING STIFFNESSES
k <- c(5,10,15,20,25)    # EACH STIFFNESS IS A DIFFERENT CASE

# COMPUTING THE FORCES FOR EACH CASE
F1 <- k[1]*x    # CASE 1: k = 5 N/m
F2 <- k[2]*x    # CASE 2: k = 10 N/m
F3 <- k[3]*x    # CASE 3: k = 15 N/m

# PLOTTING FORCE VS. DISTANCE
plot(x,F1,type="l",main="Force vs. Distance",xlab="Distance (m)",ylab="Force (N)",ylim=c(0,8))

# ADDING NEW CASES ON SAME PLOT
lines(x,F2,col="red")
lines(x,F3,col="blue")

# PLOT LEGEND
legend("topleft",title="Stiffness",c("5 N/m","10 N/m","15
N/m"),pch=c("-","-","-"),col=c("black","red","blue"))
grid ()
```