

Student Teacher: Christina Bifulco

Class: Pre-Calculus

Date: Friday, March 7, 2008

*Topic:*

Graphing Sine and Cosine With Varying Period and Amplitude

*New Jersey Core Curriculum Standards:*

4.3.12.B. Functions and Relationships, Grade 12

- Analyze and explain the general properties and behavior of functions of one variable, using appropriate graphing techniques

4.5.C. Connections, Grade 2-12

- Recognize that mathematics is used in a variety of contexts outside of mathematics.

*Objectives:*

1. Students will be able to graph sine and cosine functions, taking into account different types of vertical and horizontal stretching.
2. Students will be able to understand the connections between graphs of sine and cosine and real-world applications.

*Materials:*

- Blackboard and chalk
- Project packet hand-outs
- Graph paper for exit cards
- Graphing Sine and Cosine Review Worksheet

*Motivation:*

Pick up the packet hand-out at the front of the room.

*Procedure:*

1. Students will have just completed a week of testing. Main objective for the day will be introduce the unit project to the students.
2. Explain different parts of project and expectations for each part including graphing a series of functions, some of which require written explanations to questions, and then graphing their own biorhythms.
  - i. What are other applications or fields where sine or cosine curves are used?
  - ii. Can you think of any that you would use in a hospital?

3. Go over how to complete your own biorhythms curve. Stress that graphing the curves are the same as graphing a normal sine curve expect it will have varying periods according to the number of days in one cycle.
  - i. Where are the zeros of a sine curve in relation to the period?
  - ii. So if the period is 23 days where would the zeros be? How about the maximum and minimum points?
4. Students will complete an exit card at the end of class giving what they feel is their weakness in the subject matter. They are given three options to write although they are encouraged to write something more detailed if there is something very particular that they don't understand. The first option is that they are completely comfortable with graphing sine and cosine and feel that they only need to do general review for the quiz. The second option is that they additional work with graphing sine and cosine with varying amplitude and periods, and the third option is that they need some additional help with working with cycles (give examples of problems for each of these two options). This exit card will be used to construct focus groups on Monday to review for quiz on Tuesday.

*Assessments:*

Students will complete exit card detailing what they consider their weakest area or misconceptions with the subject are.

*Homework:*

Complete review worksheet on the topic.

# Pre-calculus

## Project: Biorhythms and the Sine Curve

### Objective:

To understand real-world situations that are best described by the use of the sine curve.

### Activity 1-

A. Graph the following functions. For each function state the period, amplitude, vertical shift and phase shift.

1.  $y = 3 \sin x$

6.  $y = -3 + \sin x$

2.  $y = 3 + \sin x$

7.  $y = \sin(x + \frac{\pi}{3})$

3.  $y = \sin(3x)$

8.  $y = \sin 2(x + \frac{\pi}{3})$

4.  $y = -\sin x$

9.  $y = \sin(2x + \frac{\pi}{3})$

5.  $y = \sin(-3x)$

B. Graph  $y = 4 \cos x$  and  $y = -4 \cos x$  on the same coordinate axes. How are the graphs the same? How are they different?

C. Graph  $y = \cos 4x$  and  $y = \cos(-4x)$  on the same coordinate axes. How are the graphs the same? How are they different?

### Analysis of Data:

All graphs should be graphed by hand on separate coordinate axis unless specified. Include at least two full periods of the graphs. They should be neat, complete and have all labels. Graphs should be completed on graph paper. All work, including finding the amplitude, period, max/min points and zeros should be given for each graph. The explanations needed for parts B and C should be completed in full and complete sentences and typed. Activity 1 of the project will be graded according to the accuracy, neatness of the graphs and the work for these graphs, as well as the completeness and accuracy of the answers for parts B and C.

### Activity 2-

#### Background:

Recently there has been much interest in biorhythm, three cycles -- physical, emotional, and intellectual -- thought to affect our behavior.

Articles on biorhythm cite famous people -- Mark Spitz, Bobby Riggs, Billie Jean King, Marilyn

Monroe -- and allude to biorhythmic forces at universally known momentous times in their lives.

Marilyn Monroe took a fatal dose of medication on a critical day; Sirhan Sirhan shot Bobby Kennedy on a critical day; and Jack Ruby, Arthur Bremer, and the Boston Strangler each became notorious on critical days. One author claims that people take risks on critical days that they would not take on other days. He says that the Canadian Royal Air Force surveyed a number of its soldiers' heroic actions.

Eighty-eight percent occurred on critical days. He includes other statistics that indicate biorhythm is a significant predictor of good and bad performances.

The Theory of Biorhythms states that there are 3 "cycles" to your life, which started on the day you were born:

The Physical Cycle: 23 days long

The Emotional Cycle: 28 days long

The Intellectual Cycle: 33 days long

Every twenty-three days the physical cycle (strength, energy, endurance, and resistance to disease) completes a full swing from neutral to high to neutral to low and back to neutral, resulting in a pattern that graphically resembles the sine function from  $0^\circ$  to  $360^\circ$ . The days between neutral and high, high and neutral, neutral and low, and low and neutral are not quantifiable except to say that they are above neutral or below neutral. Every twenty-eight days, you complete an emotional cycle that includes periods of elation, sadness, moodiness, and creativity. On high, peak days you are most likely to be elated and creative, and on low days you are the opposite. The intellectual rhythm (alertness, memory, and reasoning ability) completes a full cycle every thirty-three days. For aesthetic reasons, we draw the biorhythm curves similar to sine curves.

At the high points in each cycle you are at your peak physically, emotionally, or intellectually. These are the days when athletic records are set, you are feeling on top of the world, or you seem particularly erudite. These peaks occur approximately once a month for each cycle. The low points are not considered your bad days -- days when you should stay in bed -- but rather days when your mind and body are at rest. It is the neutral times, called "critical days," when you should be careful lest bad things befall you. The critical days are those when the curve crosses the axis of your graph. Beware!

Now that you are ready to find out if you should enter into business arrangements, try to go for a record in the mile, or warn your students that you are not to be crossed today, we shall show how to calculate your biorhythm.

On the day of your birth all three cycles began at the same time. To find out where you are in your three biorhythm cycles, consider the following example. Suppose you were born on 7 December 1944, and it is now 1 October 1977. You must first figure the number of days you have lived from your birth date to your last birthday -- 7 December 1976. Multiply 365 by your age, 32 in this -- example  $365 \times 32 = 11680$ . You must add an extra day for each leap year ('48, '52, '56, '60, '64, '68, '72, '76). There are eight in this example. Since it is now 1 October 1977,

we must add the number of days since your last birthday, in this case 298. Thus, the number of days you have been alive is  $11680 + 8 + 298 = 11986$ .

For those of you having trouble with "30 days hath September..." here's a chart of the number of days per month: Jan 31, Feb 28, March 31, April 30, May 31, June 30, July 31, Aug 31, Sept 30, Oct 31, Nov 30, Dec 31

To compute where you are in your twenty-three-day physical cycle, divide the total number of days lived by 23.

$$11986 / 23 = 521 \text{ r}3$$

As of 1 October 1977, you have gone through 521 physical cycles plus three days. Thus, your physical cycle began again on 29 September.

On a piece of graph paper draw a vertical and a horizontal axis (fig. 1). You might wish to have a long horizontal axis to allow you to follow your cycle for a longer time period. Place the vertical axis at the left margin. The amplitude of your curve is unimportant, but it should be the same for all three cycles.

The emotional cycle is calculated in much the same way.

$$11986 / 28 = 428 \text{ r}2$$

Thus, the emotional cycle began on 30 September (see figure 2). The intellectual cycle is thirty-three days, and to graph this cycle, we perform the following:

$$11986 / 33 = 363 \text{ r}7$$

This intellectual cycle began on 25 September (see figure 3). A composite graph of figures 1, 2, and 3 is seen in figure 4. With all three curves on the same axes, you can see double and triple critical days. From this particular example, we can see that toward the middle of the month there is a quick succession of critical days. And on 28 October there is a double critical day. Beware!

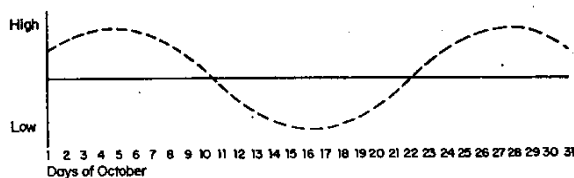


Fig. 1. A twenty-three-day physical cycle

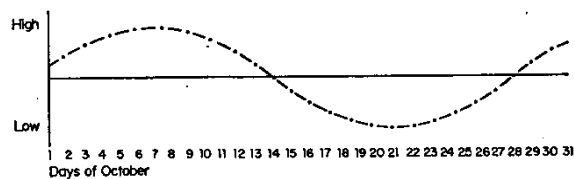


Fig. 2. A twenty-eight-day emotional cycle

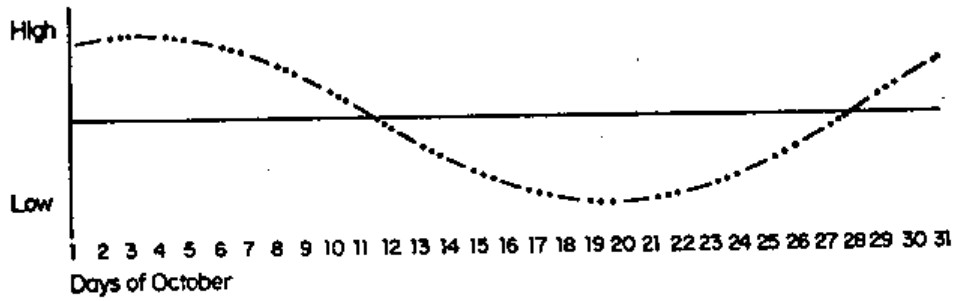


Fig. 3. A thirty-three-day intellectual cycle

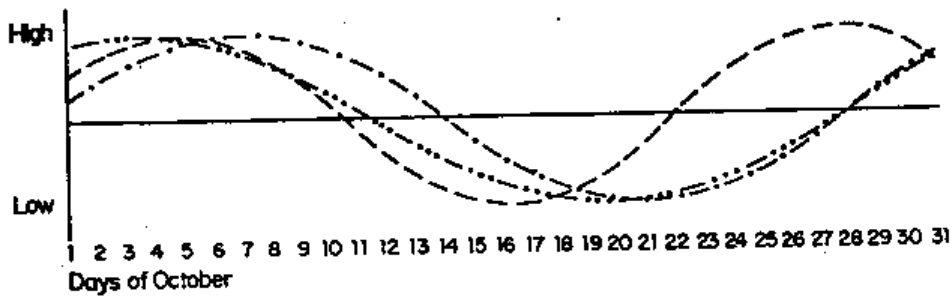
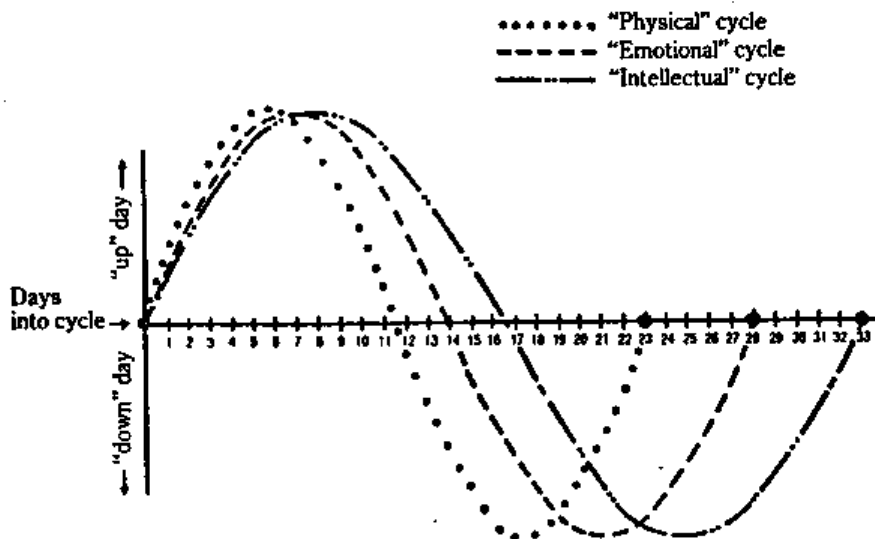


Fig. 4. A composite graph of figures 1-3

ONE COMPLETE CYCLE OF EACH



## Analysis of Data:

### *Graphing Your Biorhythms:*

Use the above example to find your own biorhythms. Use the following sheet as the cover sheet of your project. Make sure to write your name and birth date. Write down the month that you are completing your biorhythms for (Use March). Calculate the number of days that you have been alive using the first day of the month of March. Plot your biorhythms as demonstrated in the above example. Draw each graph by hand! Plot each of your three cycles on a different graph and then plot a fourth graph with all three cycles on one graph. After plotting your graphs fill out the remainder of the cover sheet with your intellectual, emotional, and physical highs and lows. Include all work as detailed above.

- Be sure to include an introduction briefly stating the background of the project and how biorhythms curves follow the sine curve.
- Also briefly explain how you completed the first part of the project including graphing your biorhythms. This should include an explanation on how you are getting the information you need in order to make your graphs.
- Write two to three paragraphs describing why you think that the graphs correctly or incorrectly portray your biorhythms.
- An additional page should be included giving another real world application of the sine and/or cosine graphs. This should be approximately three-quarters to one page typed (double spaced, 12 font) that describes the use of the graphs, and the reason that it is significant or important. Sources for this section should be cited with footnotes.
- The project should be neat and structured well so that all information can be found easily. The written part of the project should be typed. Computational work does not need to be typed, but should be neat and easily readable. Graphs should be hand drawn, neat and include scales and labels.
- Project will be graded based upon the graphs, computations for graphs, and analysis of the data as described above. Neatness and accuracy will be considered when grading.

The project will be graded using the rubric seen below. **The project will be due on March 20<sup>th</sup>. NO LATE PROJECTS WILL BE ACCEPTED FOR ANY REASON.** If you are not going to be attending school that day for any reason have someone else drop off the project for you or hand it in the day before. The project must be in Ms. Bifulco's hands by 2:30 pm on March 20<sup>th</sup> or it will be considered late and a zero for the project will be given. **NO EXCEPTIONS FOR ANY REASON.**

# Biorhythms Project

Name: \_\_\_\_\_

Period: \_\_\_\_\_

For the month of : \_\_\_\_\_ March \_\_\_\_\_

Birth day: (MM/DD/YY) \_\_\_\_\_

Number of Days Alive (as of \_\_\_\_/\_\_\_\_/\_\_\_\_): \_\_\_\_\_

Physical cycle: 23 Days

Emotional cycle: 28 Days

Intellectual cycle: 33 days

*After plotting your graphs what are:*

Intellectual Highs: \_\_\_\_\_

Emotional Highs: \_\_\_\_\_

Physical Highs: \_\_\_\_\_

Intellectual Lows: \_\_\_\_\_

Emotional Lows: \_\_\_\_\_

Physical Lows: \_\_\_\_\_

Name \_\_\_\_\_ Period \_\_\_\_\_

**Biorhythms Project Grading Rubric**  
Pre-Calculus

*Activity 1-*

	<b>Accuracy (3 Points)</b>	<b>Presentation (2 points)</b>	<b>Work Included (2 points)</b>	<b>Neatness (2 points)</b>	<b>Explanation (3 points)</b>
<b>Part A</b>					
Graph 1					N/A
Graph 2					N/A
Graph 3					N/A
Graph 4					N/A
Graph 5					N/A
Graph 6					N/A
Graph 7					N/A
Graph 8					N/A
Graph 9					N/A
<b>Part B</b>					
<b>Part C</b>					

- Presentation includes having appropriate labels, scales and having two full periods of the graphs
- If graphs are not completed by hand, you will loose all points in the neatness and presentation categories

*Activity 2-*

	<b>8</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
Graphs are completed accurately and neatly by hand. All graphs are on graph paper with appropriate scales and labels.								
All computations for the graphs are included, and were completed neatly and accurately.								
The analysis of the data was included and was neatly typed with no grammatical or spelling errors. This section included an introduction of the project, the process you went through to complete graphs, and why or why you do not think the graphs portray your biorhythms.								
Additional page describes a real world application of graphs and why the use of the graphs are important.								
Entire project is neat and organized. Both activities are structured well so that all information is easy to find. Project is generally well put together.								
	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>		
The cover sheet of the project is completed neatly and fully, and affixed to the front of the project.								

**TOTAL POINTS** \_\_\_\_\_ **/150**

Name \_\_\_\_\_

Date \_\_\_\_\_

Period \_\_\_\_\_

Graphs of Sine and Cosine Functions Worksheet 2  
Pre-Calculus

*Directions:* For each of the following functions complete the chart, graph all problems.

Function	Typical or image	Amplitude	Period	Zeros	Maximum Points	Minimum Points
1. $y = -2 \sin \frac{1}{2}x$						
2. $y = 3 \cos \frac{-1}{4}x$						
3. $y = -5 \sin(-3x)$						
4. $y = \frac{-1}{2} \cos \frac{-2x}{3}$						
5. $y = 3 \cos (2x)$						
6. $y = 9 \sin \frac{-x}{2}$						
7. $y = -2 \cos \frac{\pi x}{2}$						
8. $y = \frac{11}{3} \sin 4\pi x$						