

Sunny Side Up

Lori Claude, WVPT

Overview

Topic: Algebra, trigonometry and real world problems using slope as rate of change. This lesson investigates the rate of change of the sunrise throughout the year. Students will gather data from the World Wide Web, calculate slope as rate of change, and interpret data using the graphing calculator. Using their data, students will relate the rate of change to Daylight Savings Time and predict the sunrise time for a specific month of a different year.

Note: The teacher must be familiar with the following functions on the TI-83: entering data into lists, plotting data points on a scatter-plot, calculating regression equations, graphing regression equations.

Length of Lesson

90 minutes

Instructional Video/Technology

Community of Living Things #3, Biorhythms
Computer with World Wide Web access (recommended: 1 computer for every 2-3 students)
Graphing Calculator (such as TI-83)
Overhead projector with TI-83 LCD panel

Learning Objectives

The student will be able to:

- gather data from the Internet
- calculate rate of change
- graph data values using paper/pencil
- enter and manipulate data using the graphing calculator
- analyze the results of the data to choose a curve of best fit
- apply the data to predict the sunrise time for a particular month of any year

(This lesson addresses Va. SOLs Math AI.5, AI.7, AI.17; AII.15, AII.19; T.6)

Materials

Per group of 2-3 students

- data packet which includes: Instruction Sheet (attached), Data Sheet (attached), 1 piece of graph paper

Pre-Viewing Activities

This part of the lesson gives students the opportunity to review the concept of slope.

Discuss the conceptual differences between slope and average rate of change by asking students what the difference is between the two. Ask students to describe situations where it is more appropriate to talk about slope, (the incline of a road) and where it is more appropriate to talk about average rate of change (the change in the volume as water is poured into a glass).

Have the students, independently, brainstorm for applications of calculating slope versus the average rate of change. After giving them a few minutes, have the students consolidate their answers within each group of 2-3 students. Each group should then present their applications of slope and average rate of change to the class.



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If the idea of calculating sunrise does not come up, the teacher may need to prompt the students. The students will most likely focus on tangible applications. Here are a couple of possible questions that can be asked to move the students toward the concept of calculating the average rate of change for the sunrise:

- Do all applications need to be tangible?
- Name some applications that are not tangible.
- Can you think of any calculations that can be made on a daily basis?
- What are some daily calculations that we, as humans, keep track of?

Focus for Viewing

The video is going to talk about sunrise as being "more than the beginning of another day"; ask students to listen for at least 3 other significant connections the sunrise has for our everyday life.

Viewing Activities

PLAY the tape *Community of Living Things #3* from the beginning of the program. **STOP** the video at 00:46 when the video says ". . . and has not gone undetected by living organisms on Earth." This clip is very brief but, it will start the students thinking about the effect that the sunrise has on our everyday life. After viewing the clip, discuss with the students the attributes of the sunrise that the video talked about and then ask them to expand on this list.

Answers:

- yearly cycle
- predictable length of day
- duration of sunrise
- effect on living organisms

Post-Viewing Activities

1. Data Gathering

<<http://www.usatoday.com/weather/wsunrise.htm>>
Have the students use the World Wide Web to look up the sunrise times for the year. Have students

choose the same date and latitude line for each month of the year. As the students are collecting this information, they should be filling out the Data Sheet. After completing the sunrise times for each month, the students then need to calculate the average rate of change between each month and record the answers on the Data Sheet as well. Students will graph the sunrise times on the piece of graph paper provided in the Data Packet. The horizontal axis should be the month and the vertical axis should be the time of the sunrise (times of the sunrise should be converted into decimal values).

2. Data Analysis

a. Discuss questions 1-3 from the Instruction Sheet. Answers:

1. March-April
2. Daylight Savings Time
3. When the rate of change is positive, the days are getting shorter and the sunrise is getting later in the morning (moving forward in time). When the rate of change is negative, the days are getting longer and the sunrise is getting earlier in the morning (moving backward in time).

b. Have the students enter the data into the list features of the TI-83. L1 should contain the month numbers, for example, January = 1, February = 2, March = 3, etc. L2 should contain the sunrise times. The sunrise minutes will need to be converted into decimal.

c. After the data is entered, the points should be plotted on a scatter-plot. When analyzing the scatter-plot, discuss the shape of the graph. Ask the students what type of curve would best fit the data and why. Most likely the students will say that the best curve would be a parabola. (Do not correct them.)

d. Use the regression feature of the TI-83 to come up with an equation for the parabola of best fit. If you make sure that the diagnostics are turned on, you can also talk about the closeness of the fit of the parabola. Transfer the regression equation over to the equation graphing screen and graph the parabola on the scatter-plot so the students can see how close the graph is to the points.

e. Ask the students what the predicted sunrise will be at a date 2 years from now using the best fit parabola. The students should realize at this point that a parabola is not a good choice for a curve of best fit.

f. Refer back to the list of attributes that the video gave to the sunrise. The main thing that you want the students to focus on is that the sunrise is cyclic, and that being cyclic means that a curve of best fit would also have to be cyclic—a trigonometric sine curve.

g. Go through the regression equation steps again using the sine regression. After the sine curve is graphed with the scatter-plot, discuss how this is a better predictor for future sunrises.

h. Have the students complete the questions from the data packet.

Assessment

Assess students on their data packet questions, tables, and graphs as well as the scatter-plot and regression equations on the TI-83.

Action Plan

Have the students repeat the lesson but use the sunset times instead. After completing the sunset part, have the students correlate the sunrise/sunset rate of changes with the time of the year that clocks are changed for Daylight Savings Time. Have students discover the relationship between positive/negative rates of change for both the sunrise and sunset together, with regard to the length of the day. Have the students describe why the sunrise and sunset rate of changes are opposite signs most of the year.

Extensions

Social Studies: Have the students research on the World Wide Web why Daylight Savings Time was initiated and when it was started. Have students dis-

cuss the effects DST has had on various industries, e.g. farming, manufacturing, office, homes.

Science:

- Have the students incorporate the rotation of the Earth around the sun to determine any effect that that may play on the duration of the day.
- Have the students work through the problem using the moon's time to see if there is any common way that people incorporate this into the calendar.
- Have the students work through the problem using another planet's information.

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Instruction Sheet and Questions

Name: _____

Using the Internet, complete the following steps and answer the accompanying questions.



1. Go to <http://www.usatoday.com/weather/wsunrise.htm>
2. Choose one date and one set of latitude coordinates for each month (Each month should use the same date and latitude.)
3. Record the data for the sunrise onto the data sheet. (The minute value should be converted into decimal.)
4. Graph the data for the sunrise on the piece of graph paper.
5. Find the average rate of change between each month and record this on the data sheet. (avg rate of change = change in time / number of days between)

Questions

1. Between which two months does the greatest change occur for the sunrise?

2. From your experiences, what major calendar change takes place at that time of the year?

3. In calculating the average rate of change for the sunrise, you should have gotten some positive values and some negative values. Explain why this happened in terms of what you know about that time of the year.

4. Predict the approximate sunrise time for the following months:
 - a. June 2003 _____
 - b. May 1999 _____