Exploration of the Rate of Change

Concepts

- Distance-time graphs
- Rate of Change
- Slope
- Problem Solving
- Critical Thinking

Overview

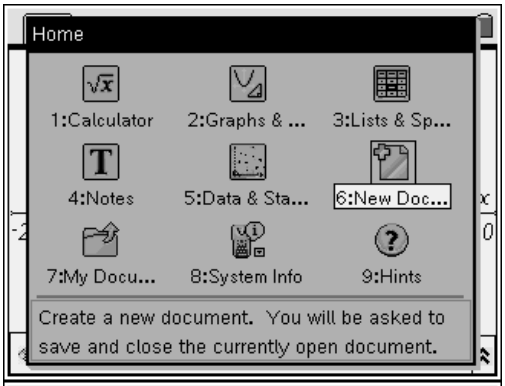
Students will investigate the relationship of rate of change and how it relates to slope by utilizing a CBR2 to collect distance-time data and analyzing the data.

Materials

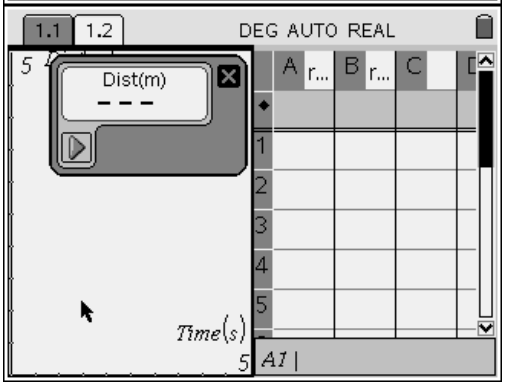
--Nspire or Nspire CAS Handheld
--CBR2
--Appropriate cables
--Student Handout

Collect Data

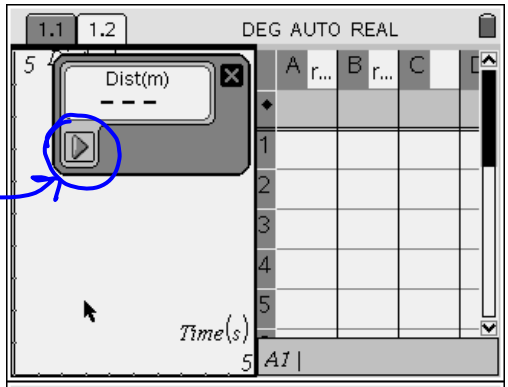
1 Turn on the Handheld and open a new document.
--Home, New Document



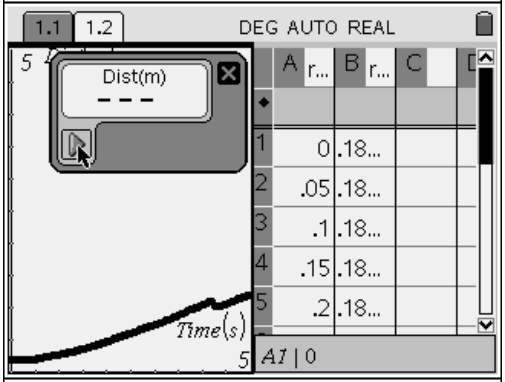
2 Connect the CBR2 and activate it by pressing the trigger button
--a Graphs and Geometry and a Lists and Spreadsheets page should appear on the Nspire



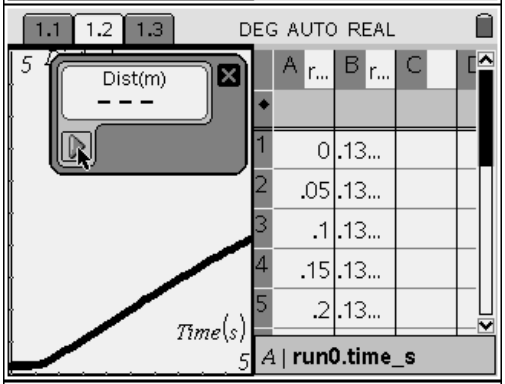
3 Practice collecting data by pressing the "Play" button



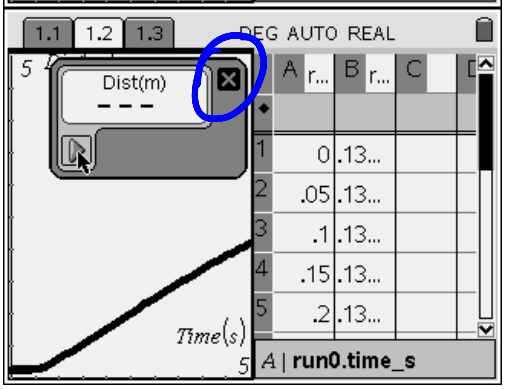
4 As you collect data, a graph of the data will be generated and the first two columns of the spreadsheet will be populated with the data points.
--The first column is the data for the time and the second column is the data for the distance.



5 Students should collect data until they have a line that is fairly straight.

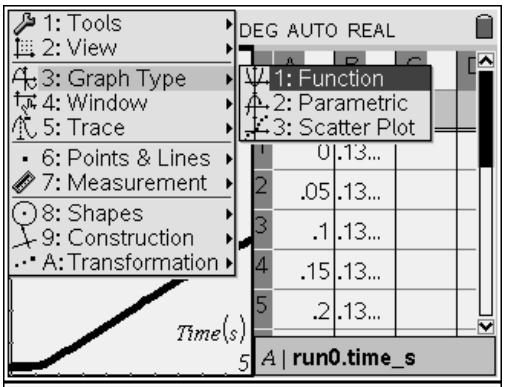


6 Once a fairly straight line is obtained, close the data collection box by clicking the "X" in the upper right corner.

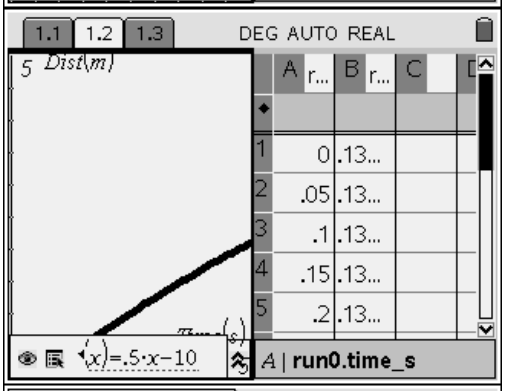


Data Analysis

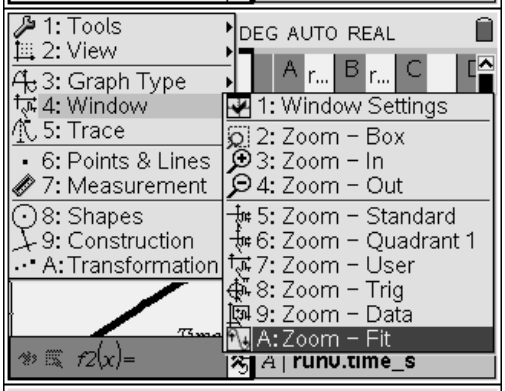
7 Change to a Function Graph: Menu, Graph Type, Function

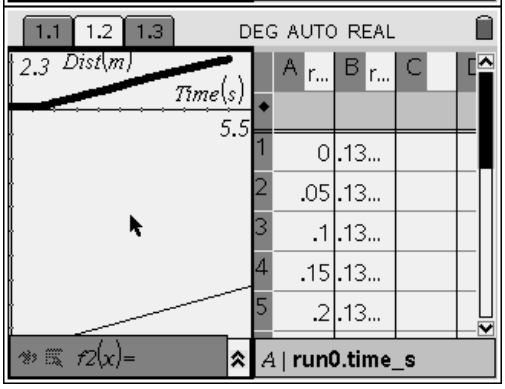


8 Insert an equation which could fit the data.

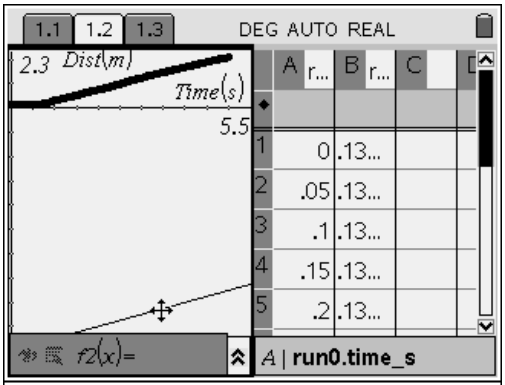


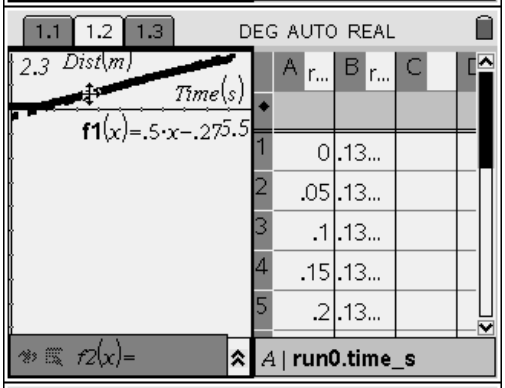
9 To see both your line and the data on the screen, press Menu, Window, Zoom-Fit

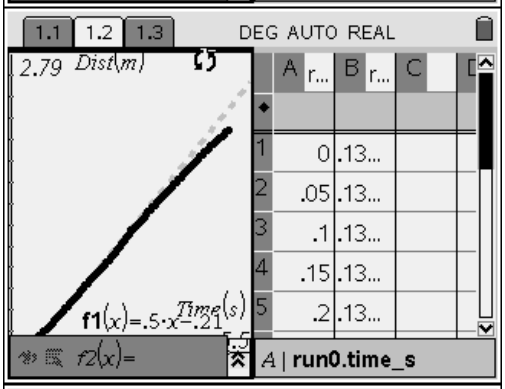


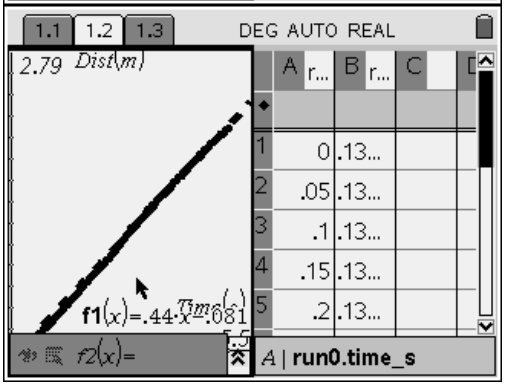


10 Now you can move your line around to better fit your data. Move the pointer close to the line, when either the ✣ or ↻ or appear, Ctrl Click on the line. Using the NavPad, move the line around. Press Esc to let go of the line.
--Continue adjusting the Window to better see both the data and the line.

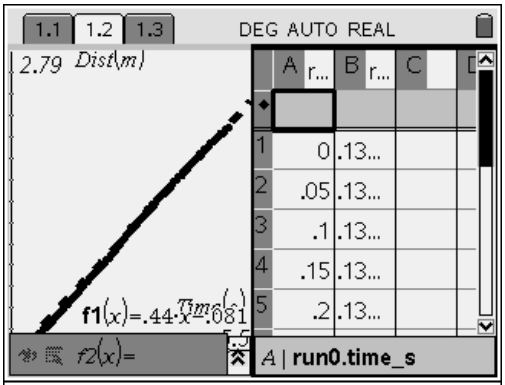
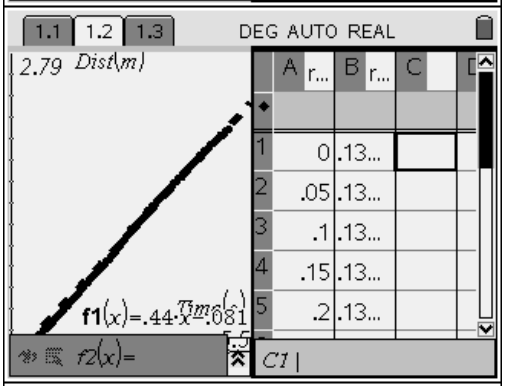
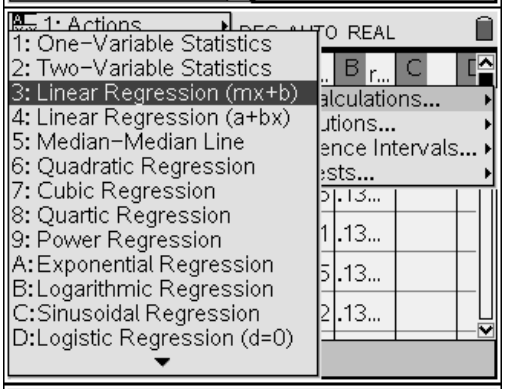
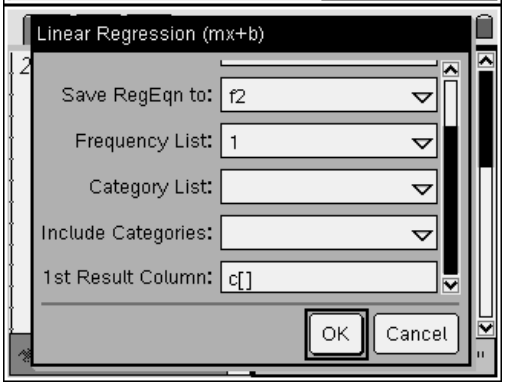




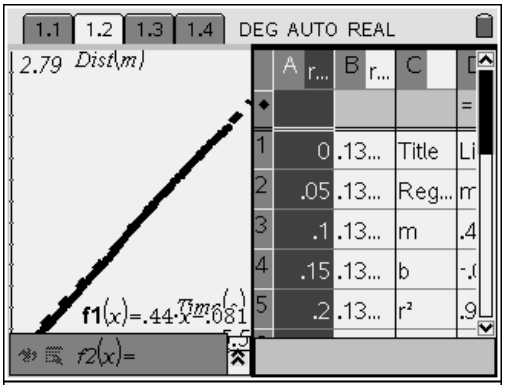




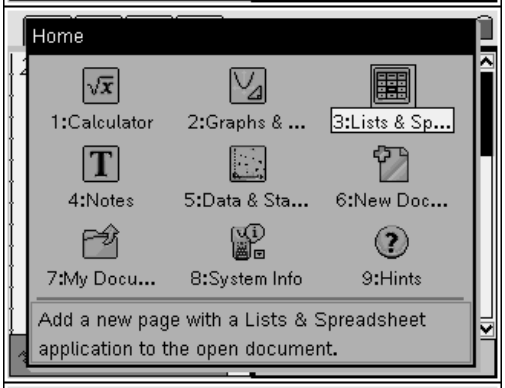
11 On the student worksheet, answer the first 3 questions regarding the line you have found to model your data.

12	Move to the Spreadsheet by pressing Ctrl, Tab (the spreadsheet becomes active)	
13	Using the NavPad, move the selection box to an open cell.	
14	Perform a linear regression on the data to determine the line of best fit. --Menu, Statistics, Stat Calculations, Linear Regression(mx+b)	
15	Fill in the information by selection the appropriate data columns. X-List: run0time_s Y-List: run0dist_m SaveRegEqn to: f2 Frequency List: 1 Category List: (leave blank) Include Categories: (leave blank) 1st Result Column: c[ ]	
16	Answer questions 4 and 5 on the Student Worksheet	

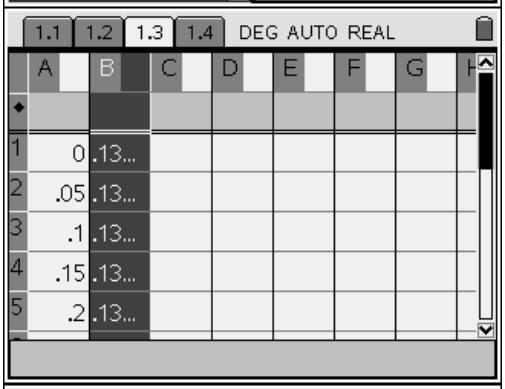
17 Select the data: Use the NavPad to arrow to the very top of the column until it is selected. Ctrl C to copy the data.



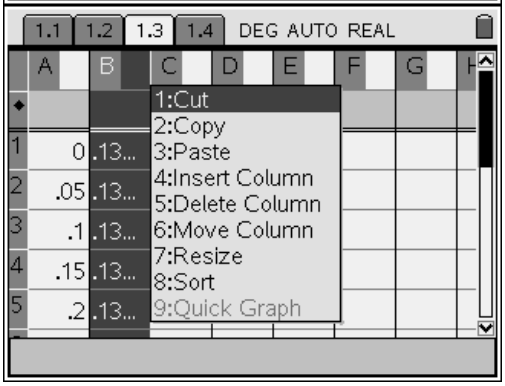
18 Open a New Lists and Spreadsheets: Press Home and Lists and Spreadsheets

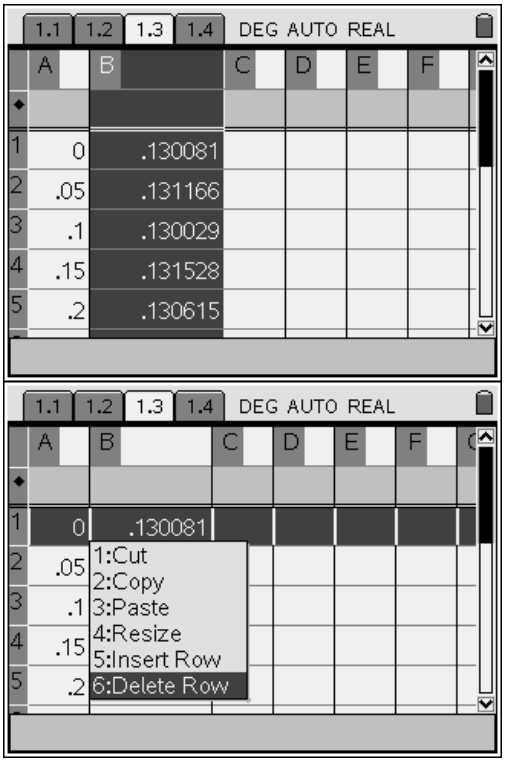


19 Select the same column of the new spreadsheet and press Ctrl V to paste the data. Use the NavPad to arrow to the very top of the second data column until it is selected. Ctrl C to copy the data into the new Spreadsheet.



20 Now delete the data which is zero or constant. (You may need to resize the columns: with the column highlighted, Ctrl Menu, Resize, Use the NavPad to change the size, Press Enter when Finished, then Esc)



	To delete rows: Select the row by using the NavPad to arrow to the left until the row becomes highlighted. Ctrl Menu, Delete Row.	
21	Perform a Linear Regression on the Remaining Data. Answer the remaining questions on the Student Worksheet.	
22	Continue with Classroom Discussion.	

Extensions:

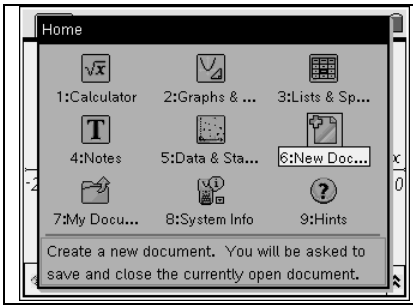
1) Collect data of various friction powered cars. Find the average speed of the cars and compare speed, car size, tire size, and at least three other factors chosen by the students.

2) Collect data of a bouncing ball, find the equation which matches a small portion of the data. (quadratic, decay, etc)

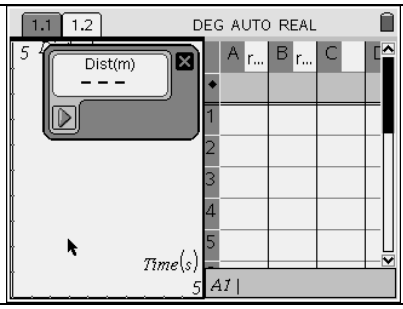
3) Use a temperature probe to investigate rate of change in liquids.

4) Discuss in depth, the mathematical process of linear regression and best-fit lines.

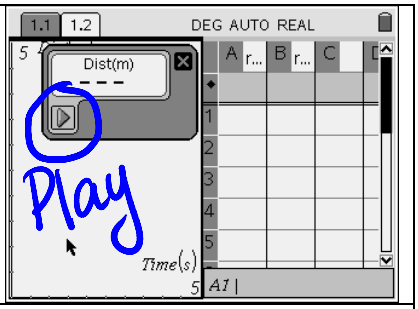
Screen Shot Summary



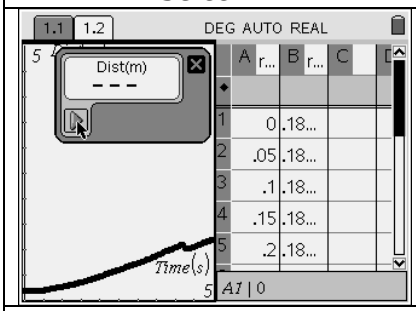
Screen 1



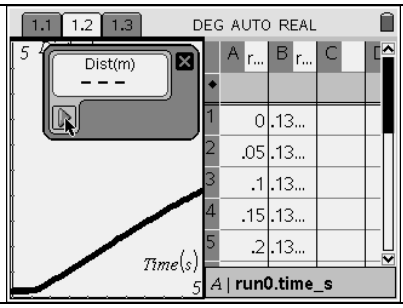
Screen 2



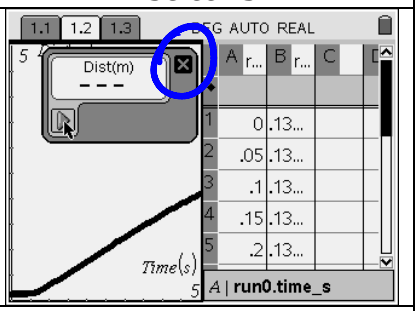
Screen 3



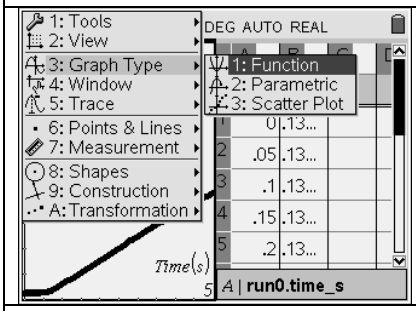
Screen 4



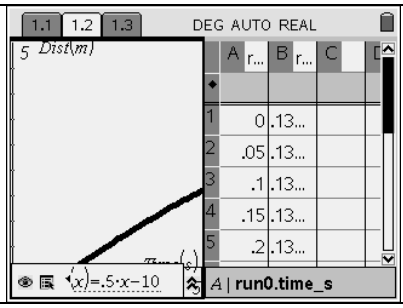
Screen 5



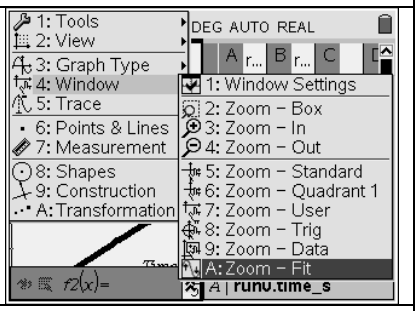
Screen 6



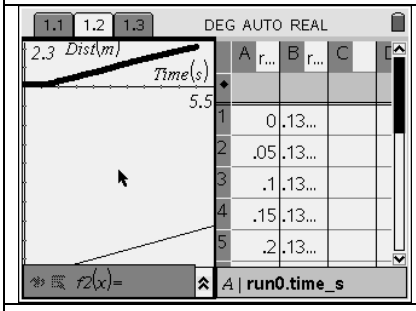
Screen 7



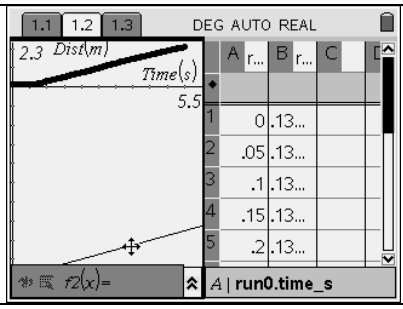
Screen 8



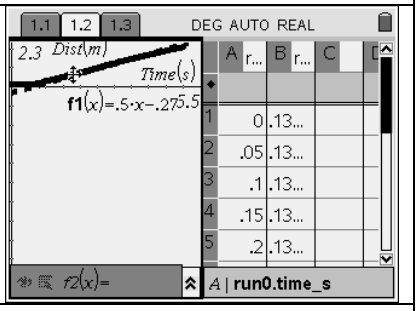
Screen 9



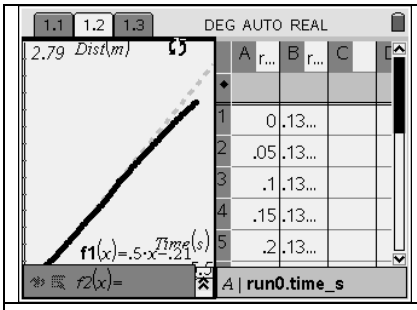
Screen 10



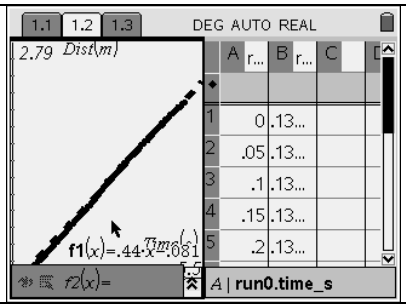
Screen 11



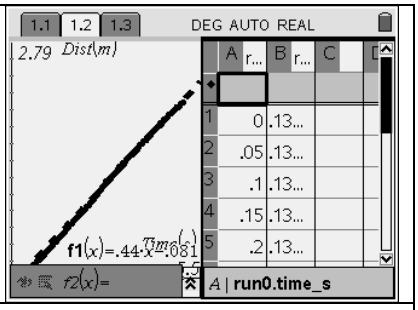
Screen 12



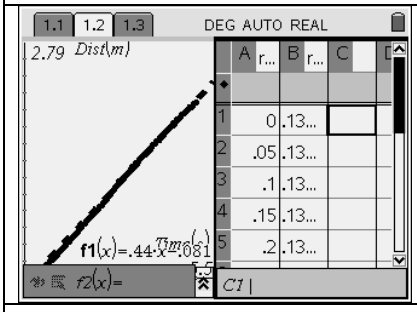
Screen 13



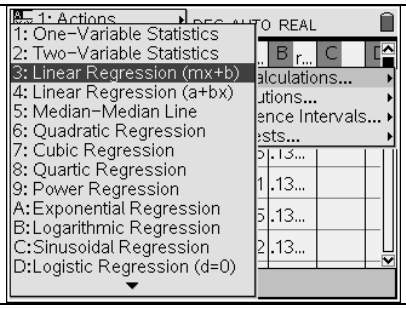
Screen 14



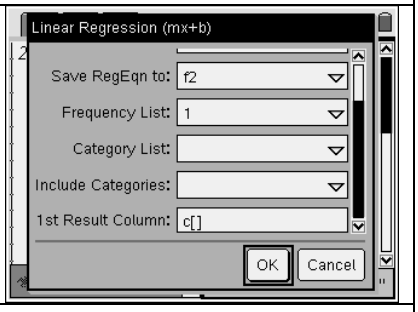
Screen 15



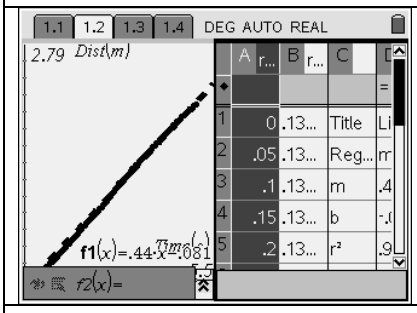
Screen 16



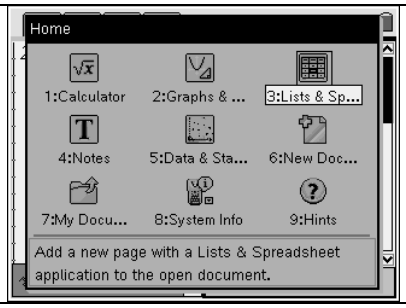
Screen 17



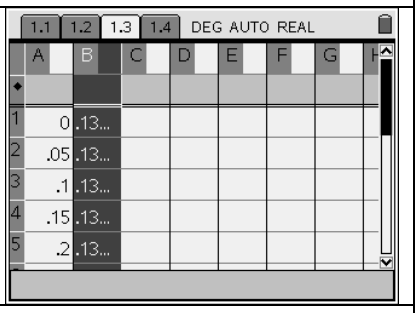
Screen 18



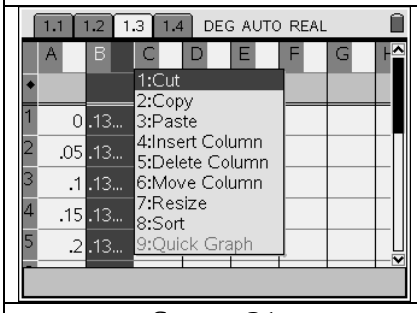
Screen 19



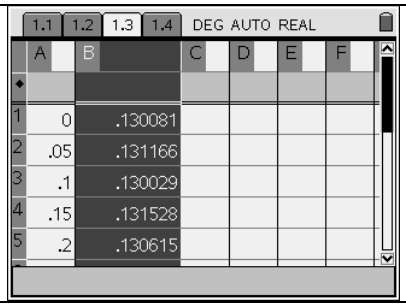
Screen 20



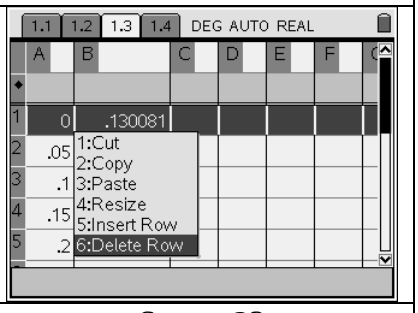
Screen 21



Screen 21



Screen 22



Screen 23

Investigating Rate of Change
Student Worksheet

NAME: _____

Class Period: _____

Answer the following questions regarding your work on the Nspire.

1) What is the equation of the line which models your data? Identify the slope and y-intercept.

_____

_____

2) Do you feel this line is a good representation of the data? Why are why not? (Does the line tell the entire story of what is happening?)

_____

_____

_____

_____

_____

_____

3) Do you have any data points which do not fall on the line? How would you explain these points?

_____

_____

_____

_____

4) How do your regression values compare with the equation you found?

5) Do you think you could make your regression line fit the data even better? How?

6) After deleting zero or constant data, how does your linear regression relate to the first linear regression? Explain.

7) How does this new regression compare to the slope and y-intercept of the line you fit to the data?

8) Is it okay to delete data that does not fit a model? Why or why not? Explain.

_____

_____

_____

_____