ON YOUR MARK, GET SET, REACT

You are driving down the highway at 100 km/h, listening to music and having a conversation with your friends when suddenly the brake lights of the car in front of you turn on. You will try to hit the brakes and slow down your car but there is a time delay before you really do that. This delay is called your reaction time - the time it takes for the body to react to the stimulus of the brake lights. During this period of time, your car is still moving at the same HIGH speed. How far will your car travel before your are able to apply the bakes? This distance is dependant on both your reaction time and the speed at which you are travelling.

In this activity we will use the TI-83+ and the Calculator Based Ranger (CBR) to determine your reaction time and then calculate the distance your car would travel before you can apply the brakes. Of course, once you apply the brakes your car still moves before it comes to a complete stop, but we will leave those calculations for a another time. They can get quite complicated.

Procedure

1. Work with a partner for this activity.

2. Link the CBR and the TI-83+ using the black link cord.

3. Turn the calculator on and press the APPS key.

4. Select `2:CBL/CBR` and following the on-screen instructions.

5. Select `3:RANGER` and following the on-screen instructions.

6. Select `1:SETUP/SAMPLE`

7. Press Í to change `REALTIME` to `no.`

8. Press † and change the `TIME(S)` to 2 and press Í .

9. Your calculator screen should have the following settings:

```
REALTIME: no
TIME(S): 2
DISPLAY: DIST
BEGIN ON: [ENTER]
SMOOTHING: NONE
UNITS: METERS
```

10. Press the } until `START NOW` is marked with an arrow. Press Í . You are ready to collect data..

11. With a tack, attach a small paper plate to a metre stick. This gives more of a surface area for the CBR to collect the data.

12. With the CBR on the floor, have Partner A hold the metre stick so that the plate is approximately one metre from the CBR. Make certain the plate is directly over the sensor.

13. Partner B should be ready to catch the metre stick with his/her thumb and finger.

14. Partner A should press Í when ready to start collecting data. Partner B needs to watch the metre stick to be ready to catch it as quickly as possible after it is released. The CBR is collecting data for 2 seconds so the releaser should slightly vary the time he/she releases the metre stick after pressing Í so that the catcher cannot predict when to catch.

15. After 2 seconds the calculator will read `TRANSFERRING...` and then a distance-time graph will appear.

16. Press the ~ key until the cursor is on the last data point before the graph starts to drop. The X value at the bottom represents the starting time of the trial. Record this in the table. Continue to press the ~ until the graph levels off again. This X value is the end time of your trial. Record this in the table. Your reaction time for this trial will be the difference of those two numbers.

17. Press Í and choose `5:REPEAT SAMPLE` and do 9 more trials for that person.

18. Partner A and B should switch roles and repeat steps 12 - 17. Each partner should find the average of all of there 10 trials.

19. After the last trial press `7:QUIT` instead of `5:REPEAT SAMPLE` which will end the RANGER program.

20. Give your average reaction time to your teacher for recording on the board.

DATA TABLE

	Student A			Student B		
Trial	Start Time	End time	Reaction Time	Start Time	End Time	Reaction Time
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
Average						

Questions

1. Compare your average reaction time with others in your class.

   a) Does every student in your class have the same average reaction time?

   b) Why might some people have faster reaction times than others.

2. Do you think your own reaction time might be different on a different day? Explain why or why not.

3. Calculate the class average from each individual student's reaction times. How close is your average reaction time to the class average? Are you higher or lower?

4. a) Being able to catch a falling metre stick is not very important for your survival. Think of three situations in which a fast reaction time would be important for survival.

   b) Think of three leisure activities for which a fast reaction time is important.

5. Now back to the car and brake lights situation. Since distance = speed × time, calculate the distance your car will travel before you apply the brake in the situation at the beginning of this activity. (Hint: You will need to convert your speed into metres/second first) Calculate the distance using the class average reaction time. Is the difference significant?

6. What would this distance be if you were speeding at 140 km/h?

7. What would this distance be if you were travelling at 50 km/h?

Extension Question:

What do you think is happening in your body between the time you detect the stimulus (metre stick starts to fall) and the time it takes you to respond to the stimulus (catch the metre stick)?

EXTENSION ACTIVITIES

1. You could have the students do a much more extensive analysis of the data using mean, medians, and box and whisker plots on your TI-83+, if you wish to make this activity more of a statistics exercise.

2. You could have the students **discuss** the effects of drugs and alcohol on reaction time. Though actually doing this activity would be illegal and inappropriate for a highschool setting, I believe the results would be an excellent tool for demonstrating the negative effects of these substances in driving a car or participating in other activities where reaction time is important.

3. You could have the students conduct an experiment on the effects of age and reaction time.

STATISTICAL EXTENSION ACTIVITY

Plotting your Data

The average reaction times for all of your classmates now need to be entered into the calculator so the data can be analyzed.

1. With your calculator on, press … , then press Í . Clear entries from L_1 if necessary.

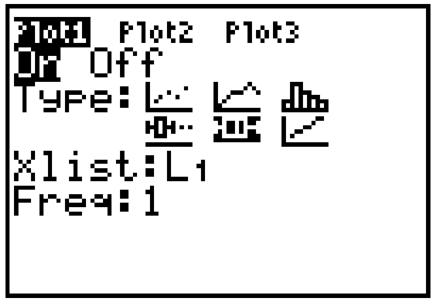
2. Enter average reaction times for you and your classmates in to L_1.

3. Press … , use ~ to select CALC, and press Í .Press Í again and use the † key to record the results in the table below.

minX (minimum time)	
Q1 (the first quartile)	
Med (the median value)	
Q3 (the second quartile)	
maxX (maximum time)	

4. Press y *STAT PLOT* and make sure Plot 1 is On and Plot 2 & 3 are Off.

5. Press Í on Plot 1 and set your calculator according to the following:



6. Press p and set the window using the appropriate values from your table above.

7. Press s . You should see a "box and whisker" plot of the data you entered. Sketch your graph in the space below.

A box and whisker plot is a data representation that divides a data set into four regions. The median or second quartile separates the set into two halves. The box plot allows us to focus our attention on a few important features without the clutter that results when all data values are displayed. The first quartile (Q_1) value tells you that 25% of the average times are equal to or lower than Q_1. The third quartile (Q3) value tells you that 75% of the average times are equal to or lower than Q_3. This means that 50% of the class data is between Q_1 and Q_3.

8. What is the range of values where the middle 50% of your data is located?

9. What does the shape of the box tell you about the average reaction times for your class?

10. How many of your classmates are in the 1st and 3rd quartiles?

11. How many of your classmates are between the 1st and 3rd quartiles?

12. What are the shortest and longest average reaction times for the class?

13. If you have a whisker that is longer, explain what this means about the reactions times for the class.

14. Compare your average reaction time from to the box and whisker plot. Where does your reaction time fit on that plot?