

## Stride Pattern Analysis Laboratory – Teacher Notes

In this experiment students apply mathematics and science in order to solve a crime. This experiment could be used in physics class when students learn linear motion and establish relationships between distance and speed or in algebra when students learn properties of linear equations and model linear motion. It can also be used in anatomy when human body proportions are discussed. This lab makes a great interdisciplinary activity.

Key topics:

- Distance and average distance
- Speed and average speed
- Slope-intercept form of linear equation
- Scatter plot
- Linear regression
- Interpolation of data

The crime scene scenario provides an opportunity for sustained students engagement while meeting the needs for problem-centered learning, critical and creative thinking. It helps students to develop lab skills, research and writing skills, and communication skills. It also provides an ideal environment for the interdependent teamwork. At the same time this is an open-ended activity that:

- encourages problem solving
- encourages students to construct their own learning path
- encourages student independence as well as interdependence
- encourages students to explore using appropriate and available tools
- encourages students to discover relationships
- requires students to apply their knowledge
- requires students to use their skills of analysis and evaluation

### Materials Notes:

This experiment can be used with CBR and TI-73, 83 (without Navigator), 83+ and 84+ families of calculators. The equipment setup for the CBR with TI-83/84 family is provided below.

### Equipment Setup

1. Connect the CBR to the calculator with unit-to-unit cable using the input/output ports located on the side of the CBR and on the top edge (TI-84) or bottom edge (TI-73 or TI-83) of the calculator. Press the cable ends in firmly.
2. Turn on calculator.
3. Press **APPS** button on the calculator.
4. Choose **CBL/CBR** option from the applications. Press any key.



5. Choose the **3: RANGER** program from the **CBL/CBR** applications.<sup>1</sup> Press **ENTER** two times to get in the **MAIN MENU**.
6. From the **MAIN MENU** select **2: SET DEFAULTS**. This will give you 15 seconds time interval for data collection.
7. Use up arrow to move cursor to the option **START NOW**, press **ENTER**.
8. CBR is now ready to collect data.

```
CBL/CBR APP:
1: GAUGE
2: DATA LOGGER
3: RANGER
4: QUIT
```

```
MAIN MENU
1: SETUP/SAMPLE
2: SET DEFAULTS
3: APPLICATIONS
4: PLOT MENU
5: TOOLS
6: QUIT
```

```
MAIN MENU  START NOW
REALTIME: YES
TIME(S): 15
DISPLAY: DIST
BEGIN ON: [ENTER]
SMOOTHING: NONE
UNITS: METERS
```

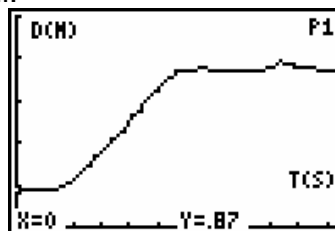
```
POINT CBR
AT TARGET

TO START PRESS
[ENTER] ON TI83P
```

### Experimental Procedure for CBR

*CBR cannot take accurate data at a distance of less than 0.5 meters (1.5 feet) from the reflective surface, so be sure that your strides start no closer than 0.5 meters to the reflective surface.*

1. When data collection is ready to begin, press **ENTER**, and the walking student should start walking away from the CBR2 counting five strides.
2. The calculator screen will display a piece-wise distance-time plot of the motion that should include a sloped linear segment corresponding to the walking part and two horizontal segments corresponding to the intervals of time when student was standing still.



3. If the experimental plot does not have a sloped linear segment, repeat the experiment. In order to do that press **ENTER**, select **3: REPEAT SAMPLE** from the **PLOT MENU**, and try again until the data are consistent.
4. After data are collected and graph is displayed you will need to select the linear part of your graph. Press **ENTER** and calculator will return to the **PLOT MENU**. Choose **2: SELECT DOMAIN**, and press **ENTER**.

<sup>1</sup> If your calculator does not have **RANGER** program, follow these steps:

- a. Press **2nd [LINK]**. Use the right arrow key to select **RECEIVE** and press **ENTER**. The calculator screen will read: **Waiting...**
- b. Flip the top portion of the CBR open and press the transfer button on the CBR that corresponds to your calculator. The calculator screen will read: **Receiving...**
- c. When transfer is completed, press **2nd QUIT**.

5. Calculator will ask **LEFT BOUND?** Use left and right arrows to move cursor to the first point on the linear piece of your graph and press **ENTER**. Then calculator will ask **RIGHT BOUND?** Use left and right arrow to move cursor to the last point on the linear piece of your graph and press **ENTER**.
6. In order to analyze the data, you will need to quit the program. Press **ENTER**. From the **PLOT MENU**, select **5: QUIT**. Time is stored in List 1 and distance is stored in List 2 of the calculator.

### **Creating Stride Data Left at the Crime Scene**

In order to create realistic stride pattern, ask a person with one of the heights provided in the crime scene scenario to start walking for 2 strides and then speed up and run for 3 more strides. This will give students increasing stride length and will allow them to use data from both walking and running. In order to mark the strides you can do one of the following:

- Mark the bottom of his/her shoes with paint, let them create a pattern on a poster board or roll of paper that you can use later for the students.
- Walk/run along the person and place stick-it notes at the front of each foot.. Cut out the footsteps, and measure the distances between each step so you can later place the paper footsteps in exactly the same pattern.
- Make this pattern outside using black tempera paint and take students outside for measurements. This is most realistic approach.

It will also make it more fun if you have a “police” tape to fix it around the stride pattern left at the “crime scene” for your class.