Beach Ball Toss

0. You will be tossing a beach ball straight up above a motion detector. You will collect data of the height of the beach ball as it changes in time. You will find a best fit equation for the height as a function of time.

1. Below, sketch what you think the graph of the beach ball's height will be as a function of time.
   - Put the height of the beach ball above the floor, on the y-axis and time on the x-axis.
   - Make sure to include units.

2. Make a few practice tosses of the beach balls directly above the motion detector.

3. Now try to get good data. Connect the CBLII, Calculator, and Motion Detector using the appropriate cords and ports. Go to SETUP in EASY DATA and set the time interval for data collection to .02 seconds and the number of samples to 100. Make sure the motion detector is on the floor directly beneath where you toss the ball.

4. Have one person hold the beach ball at least 50 cm above the Motion detector, hit START, when you hear the motion detector start to click, toss the beach ball up into the air directly above the motion detector. Ideally, it should fall back down onto the motion detector. This may require a couple of trials. Repeat experiment until you have "clean data" on a distance versus time graph. Compare this graph to your prediction. Show your graph to your instructor.

Check with your facilitator

5. Work **with your instructor** to trim and adjust your data.

6. Using the link cables transfer the adjusted time and distance data to each group member's calculator.

7. Make a STAT PLOT of your height as a function of time. What type of function do you feel will best model this data? Explain your reasoning.

Check with your facilitator

Beach Ball Toss Model

8. What is the domain and range of your data?

9. Find a model of your data. Is your function model a good fit? Explain your reasoning.

10. Use your model or the tables from your calculator to answer the following (support each answer with a sketch indicating how you used the graph on your calculator):

    (a) Where was the beach ball 1/10 second into the toss?

    (b) When was it at a height of 1.3 m?

    (c) What is the maximum height the ball gets to and when did this occur?

    (d) How long was the beach ball in the air during the toss?

(e) What is the domain and range of the model? Compare it to the domain and range of the data you gathered.

(f) What is the height of the ball 4 seconds after it was tossed according to your model? Does this match the physical situation?

(g) When was the beach ball at a height of 7 m? Explain.

(h) Make your WINDOW larger so you can see where the model crosses the x-axis.

- How many points does this equation cross the x-axis at? Why?

- At what values of time is the height of the ball at the ground?

- Are both of these values physically reasonable?

(i) Recall one of your favorite equations from Algebra 2, the Quadratic Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- Find the times $f(x) = 0$, using the quadratic formula.

- Compare these times to what you found off the graph.

- Write the equation of your model in factored form.

- Put the factored form of your model into standard form.

- Put the vertex form of your model into standard form.

- How do the two versions of your model compare?

Check with your facilitator