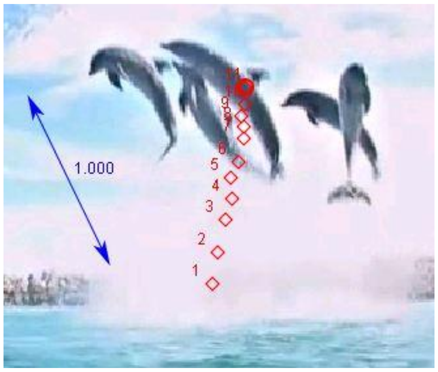
Projectile Motion: Dolphin Jump[1]



Dolphin shows often include dolphins "jumping" fairly high out of the water. When in the air, the dolphins are in projectile motion. Using this information, you can determine how big they are and how fast they leave the water (initial velocity).

Download or find in the zip file the following:

- dolphin_bow.mov
- dolphin_jump.trk

Found on the ComPADRE digital library:
http://www.compadre.org/osp/items/detail.cfm?ID=12090

The movie is a clip from the YouTube video at
http://www.youtube.com/watch?v=0_IOnjqsw1M

The "trk" file is a partially marked Tracker file and if you double click it (and Tracker is installed), it should launch a tab in Tracker (it will likely ask you where the video file is and you will have to point it to where you downloaded the mov file).

Play the video and notice that the "camera" moves at little bit to follow the dolphin. In order to track the dolphin, then, we will need to set an origin (in this case a fixed dock on the water). The"trk" file already has the position of the dolphin (about at its center of mass) marked. The scale is set so that "1" is the length of the tracked dolphin. Usually we calibrate the video with a known length to determine how many pixels=1m. In this case, we will scale the video by the acceleration due to gravity.

[11] Based on a student project by Brittany Capra, Taylor Natale and Julie Pickering.

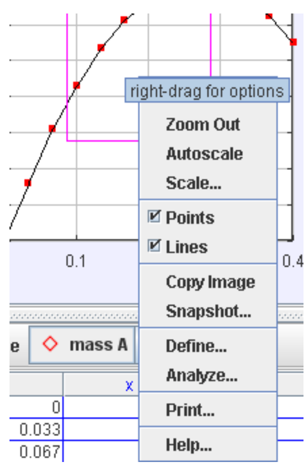
Sketch the plot of x vs t below:

Explain why the plot is a straight line:

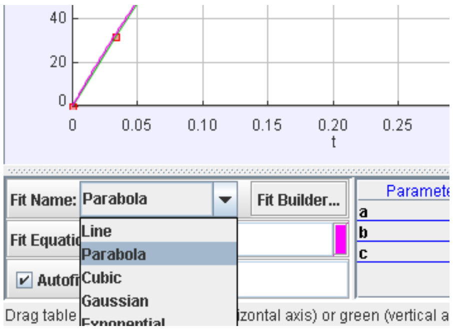
Now, sketch the y-position data as a function of time (click on the vertical axis label "x" and change it to "y").

Why is it parabolic?

We are going to fit the data of the position versus time data. `Right-click` on a plot (graph) you want to fit (y versus t for one of the masses) and choose `Analzye`:



A new window opens up with the title `Data Tool`. Click the `Fit` check-box and then, because the graph is parabolic, pick `Fit Name -> Parabola`:



What is your equation of motion?

y(t) = ____________________

Differentiating this, what is **your** equation for the velocity as a function of time?

v_y (t) = _____________________

What is the "initial" velocity in the y-direction (velocity leaving the water)?

v_{0y} = ________________

What is the acceleration (from your data)?

a_y = _______________

You should not get a value of -9.8 or anything close to that because your acceleration is in units of dolphin units/second^2. Why is that your unit instead of m/s^2?

If we assume the acceleration due to gravity is -9.8 m/s^2, what is the conversion for dolphin units to meters? For example, if students found (with different data from above):

a_y = __-3 dolphin units/s^2__________

Then they know that

3 dolphin units= 9.8 m or

1 dolphin unit = 3.2 m

What is your conversion between dolphin units and meters?

1 dolphin unit = __________ m

So, how long is the dolphin?

____

Does that seem like a reasonable number? Explain.

From your tracker data, what is the initial y-velocity of the dolphin in m/s (instead of dolphin units/s):

v_{oy} = __________________m/s

Now, go back to the graph of x versus time and fit the x-position data to a line (instead of a parabola):

x-position equation:

x(t) = ____________________

What is the initial velocity in the x-direction?

v_{0x} = _________________dolphin units/s

and in meters/s:

v_{0x} = ________________ m/s

What then is the initial speed of the launch dolphin leaving the water (magnitude of the initial velocity vector)?