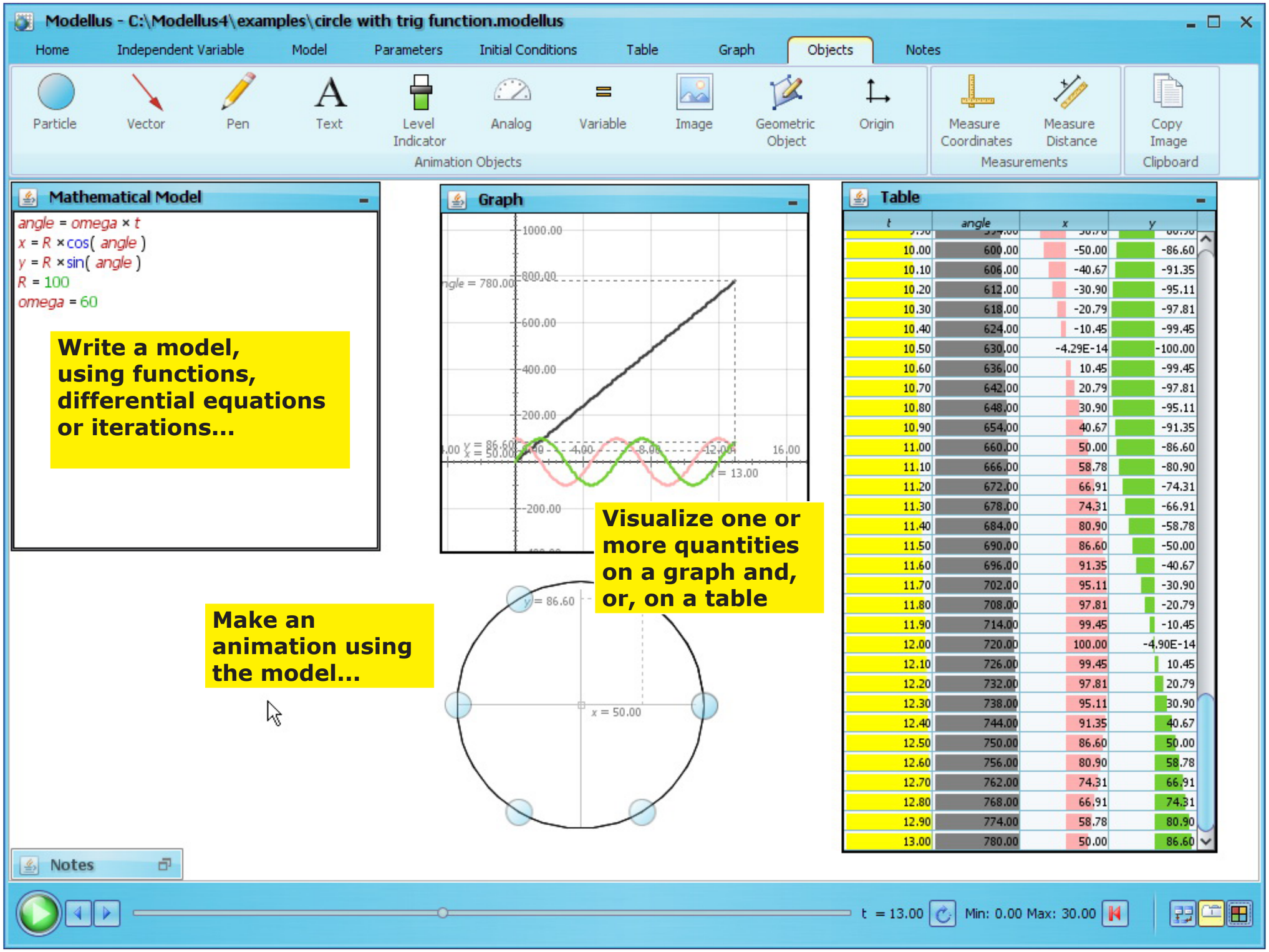
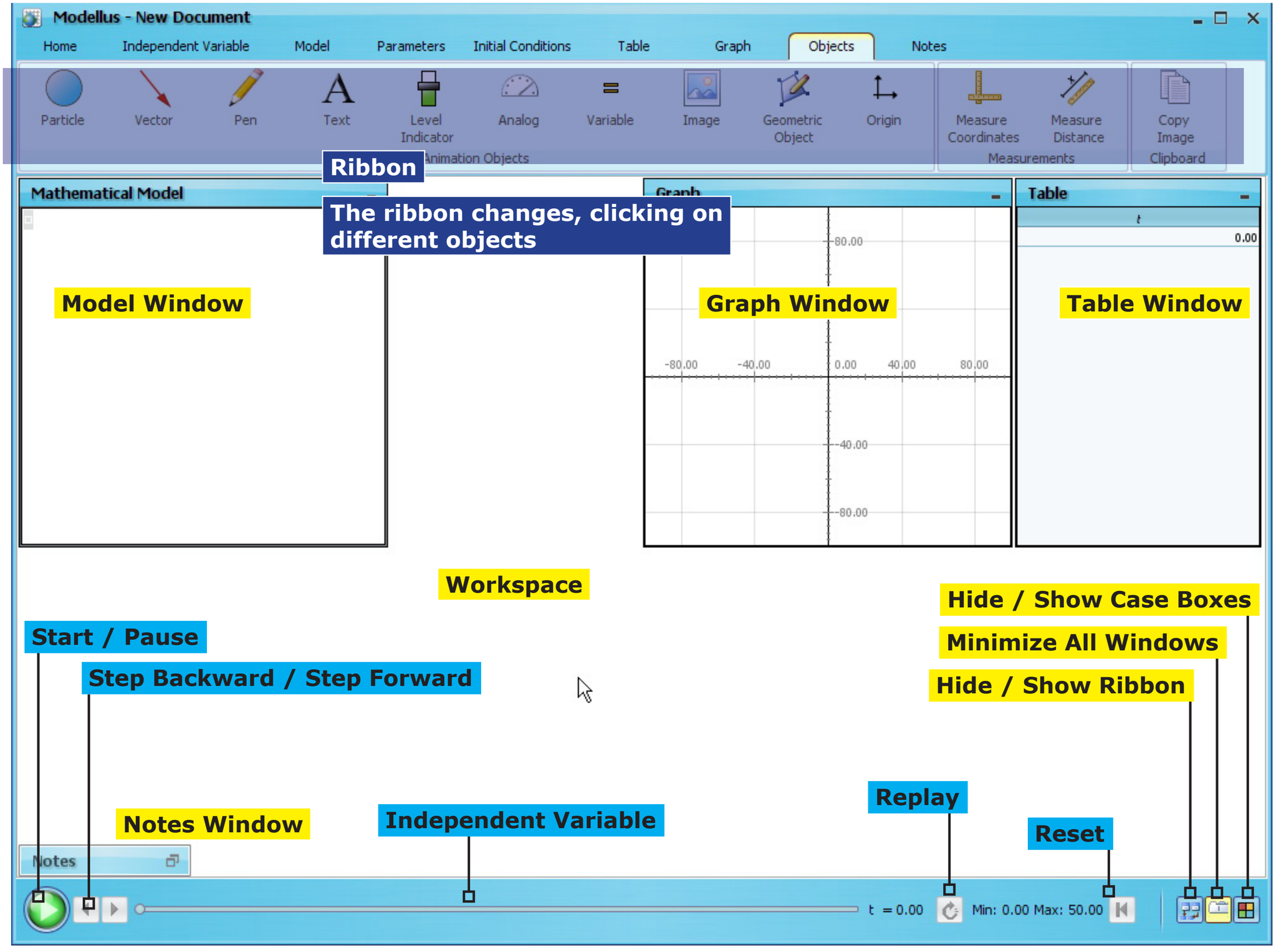
0 Modellus: the concept and uses

Write a mathematical model... and then visualise and explore it!



1 A first look of the interface

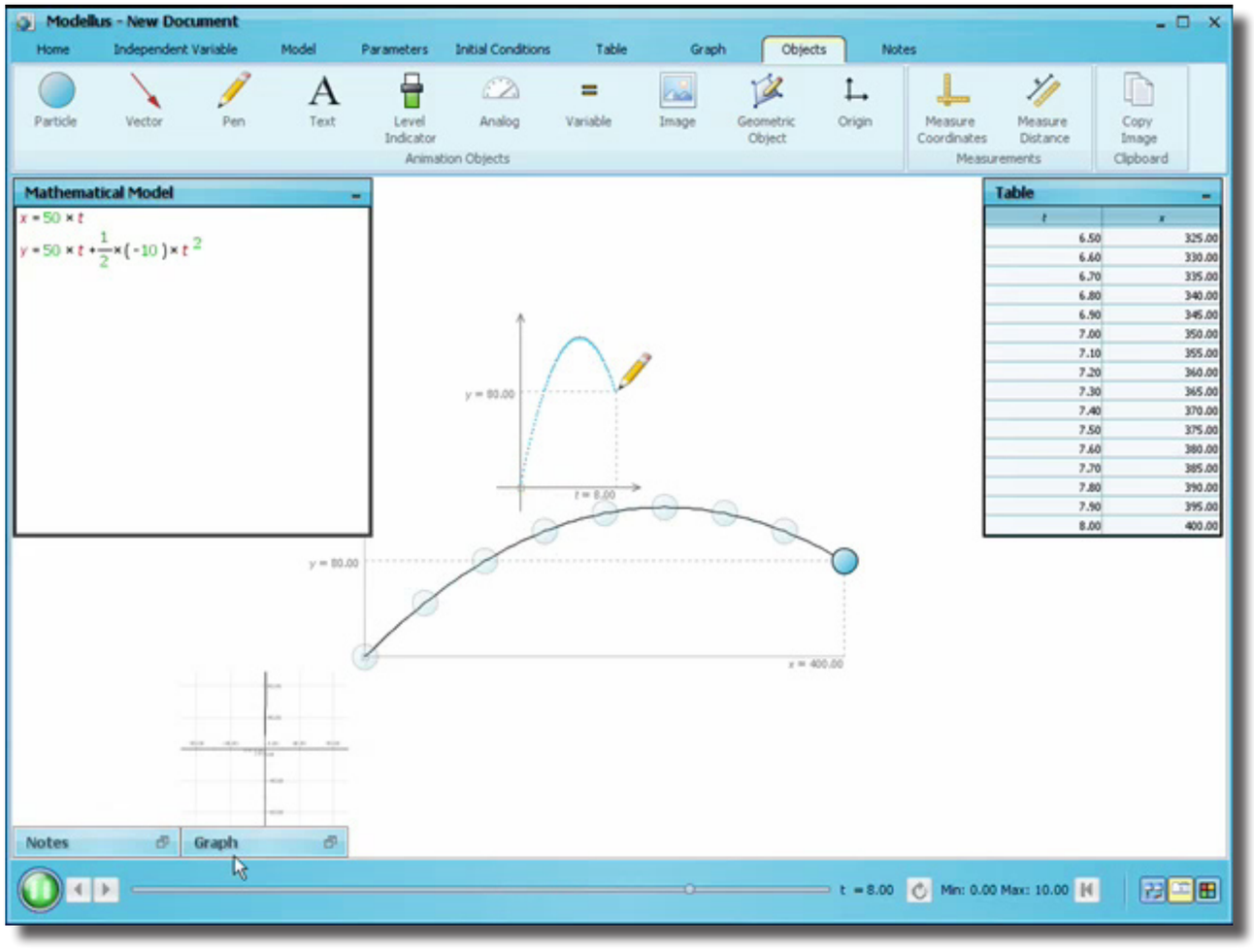
Learn how things are labelled and what they do



2 See it in action: a simple example with functions (a model of projectile motion)

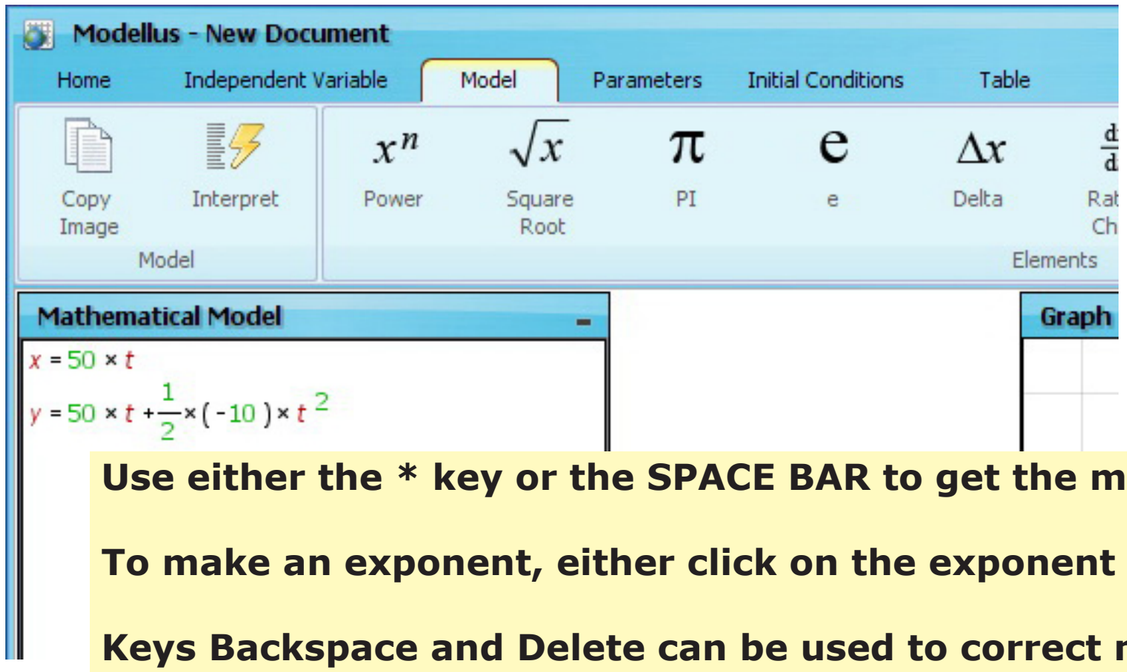
What you will get on this example that illustrates how to make a model of a projectile motion... (click on the image to see the movie)

3



2a See it in action: a simple example with functions (a model of projectile motion)

Write the model on the Mathematical Model Window...



Use either the * key or the SPACE BAR to get the multiplication sign

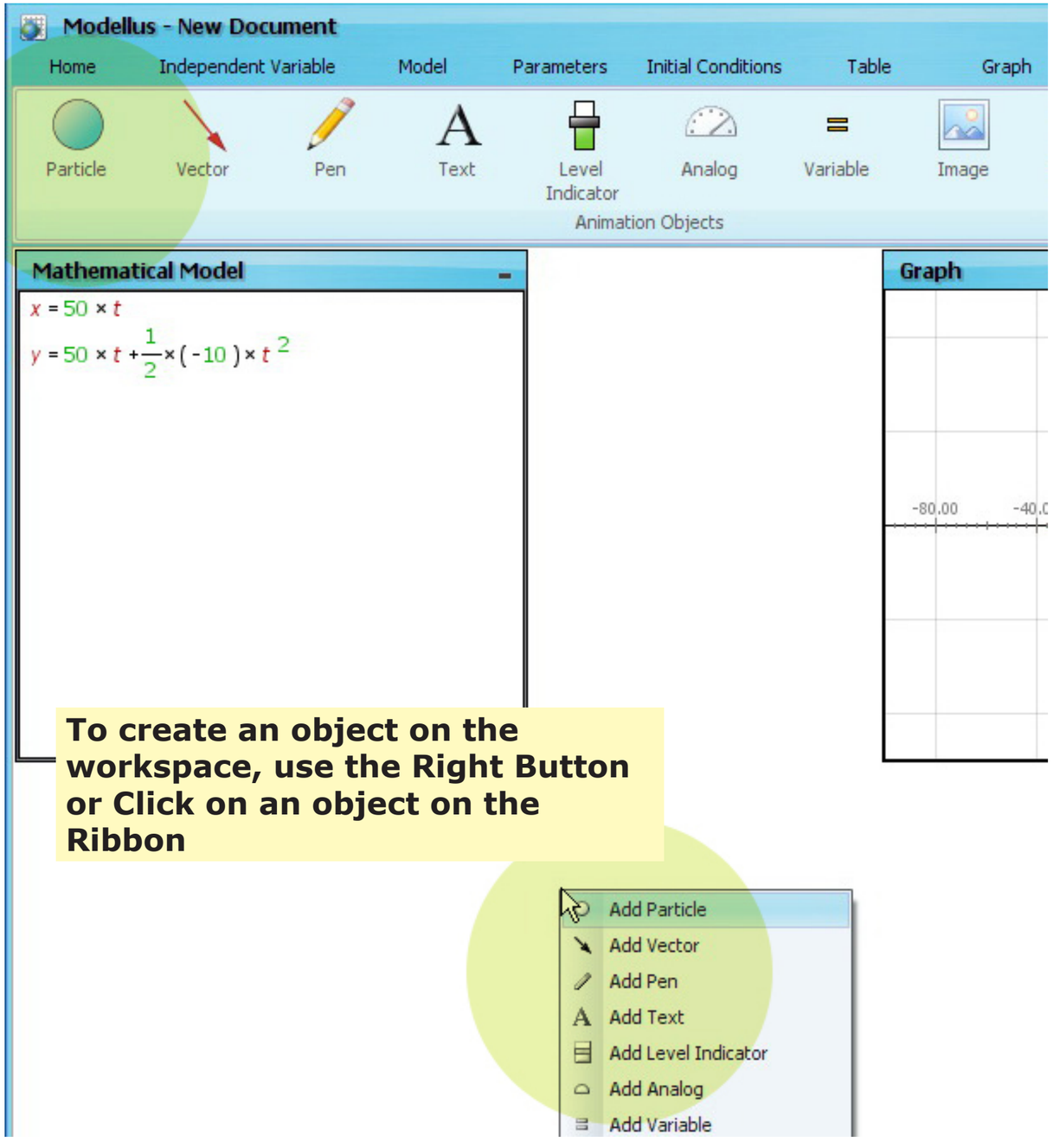
To make an exponent, either click on the exponent icon or press ^

Keys Backspace and Delete can be used to correct mistakes

Shortcuts for Copy, Cut, Paste and Undo are the usual ones (Ctrl C; Ctrl X; Ctrl V; Ctrl Z), *on the Mathematical Model Window and on the Notes Window*

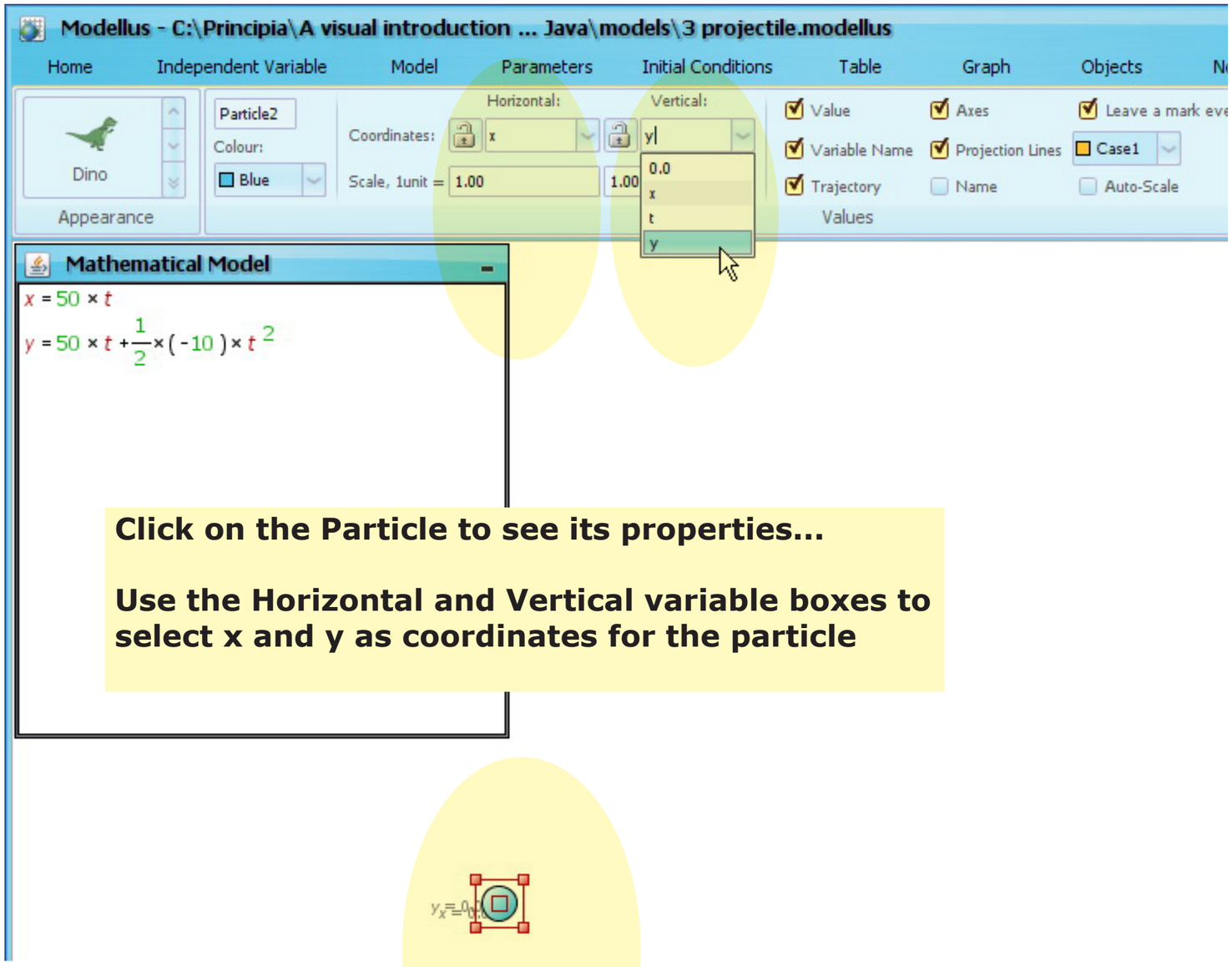
2b See it in action: a simple example with functions (a model of projectile motion)

Create a particle to see the motion of the projectile...



2c See it in action: a simple example with functions (a model of projectile motion)

Once the particle is created, select its coordinates...

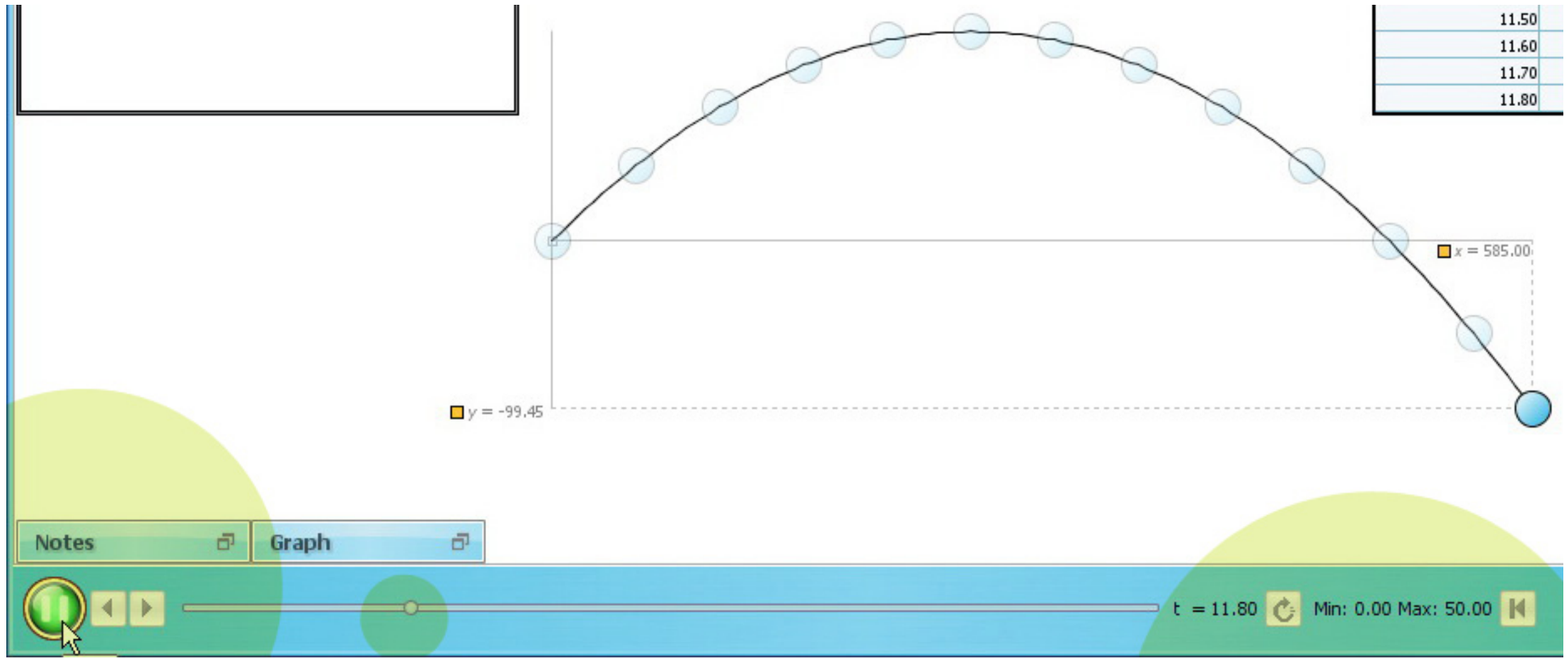


Click on the Particle to see its properties...

Use the Horizontal and Vertical variable boxes to select x and y as coordinates for the particle

2d See it in action: a simple example with functions (a model of projectile motion)

Run the model...



Run the Model...

The Run button is also the Pause button...

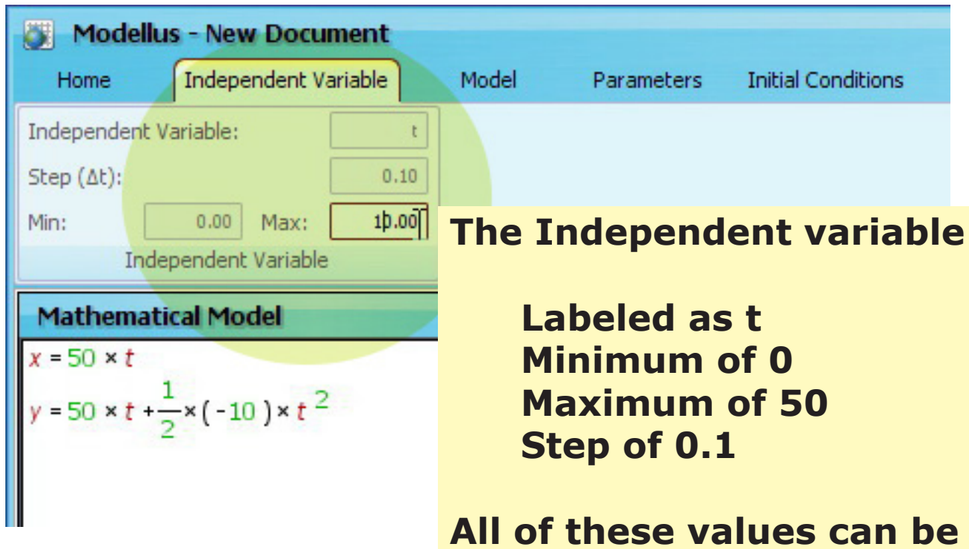
The current value of the independent variable is shown as a small ball alongside an horizontal line...

The current value of the independent variable is also shown as a number...

... as well as the Minimum and Maximum values.

2e See it in action: a simple example with functions (a model of projectile motion)

The Maximum value of the independent variable *t* is too big… but can be changed!



The Independent variable has the following default values:

Labeled as t
Minimum of 0
Maximum of 50
Step of 0.1

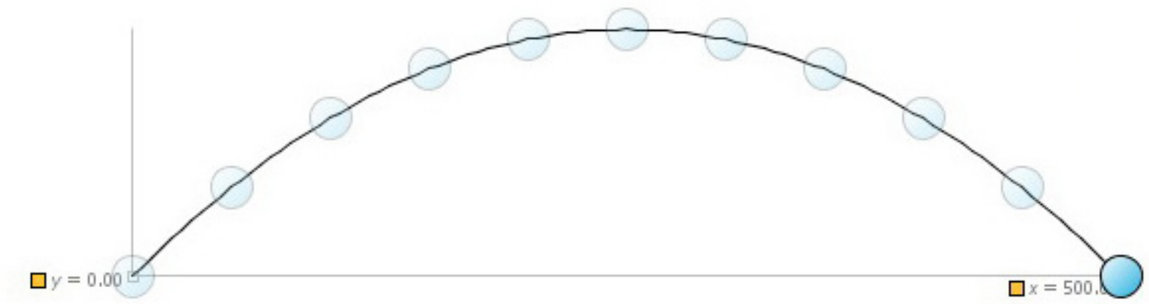
All of these values can be changed on the Independent Variable Ribbon

Define a domain [0, 10] for *t*: Minimum value is 0, Maximum is 10 units

Don’t forget to reset the Model, if necessary, using the Reset button

2f See it in action: a simple example with functions (a model of projectile motion)

Play it again...

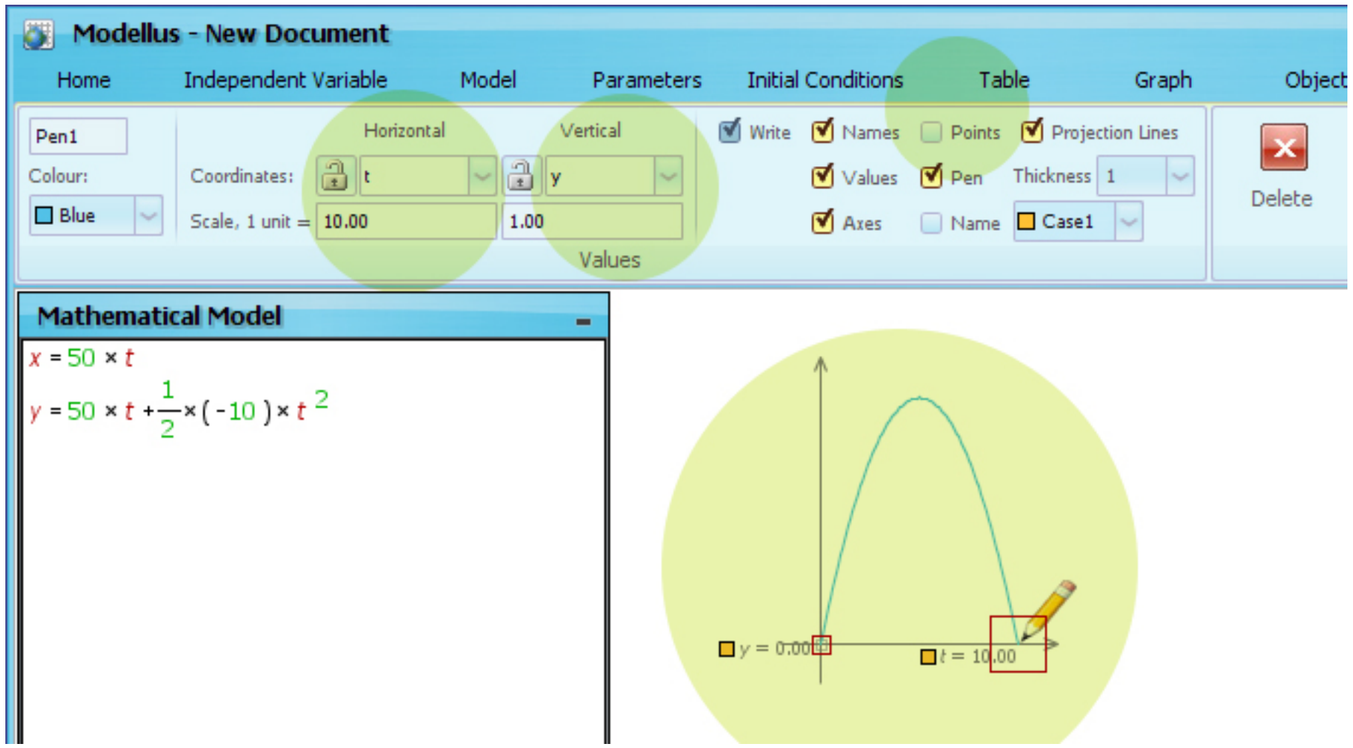


Run the model again... to check if the domain is correct

With a domain [0, 10] for *t*, the projectile fly until the same height of the launching point...

2g See it in action: a simple example with functions (a model of projectile motion)

Place a Pen on the Workspace to make a graph of the vertical coordinate *y*...



To place a Pen, use the right button or click on the icon on the Workspace Ribbon

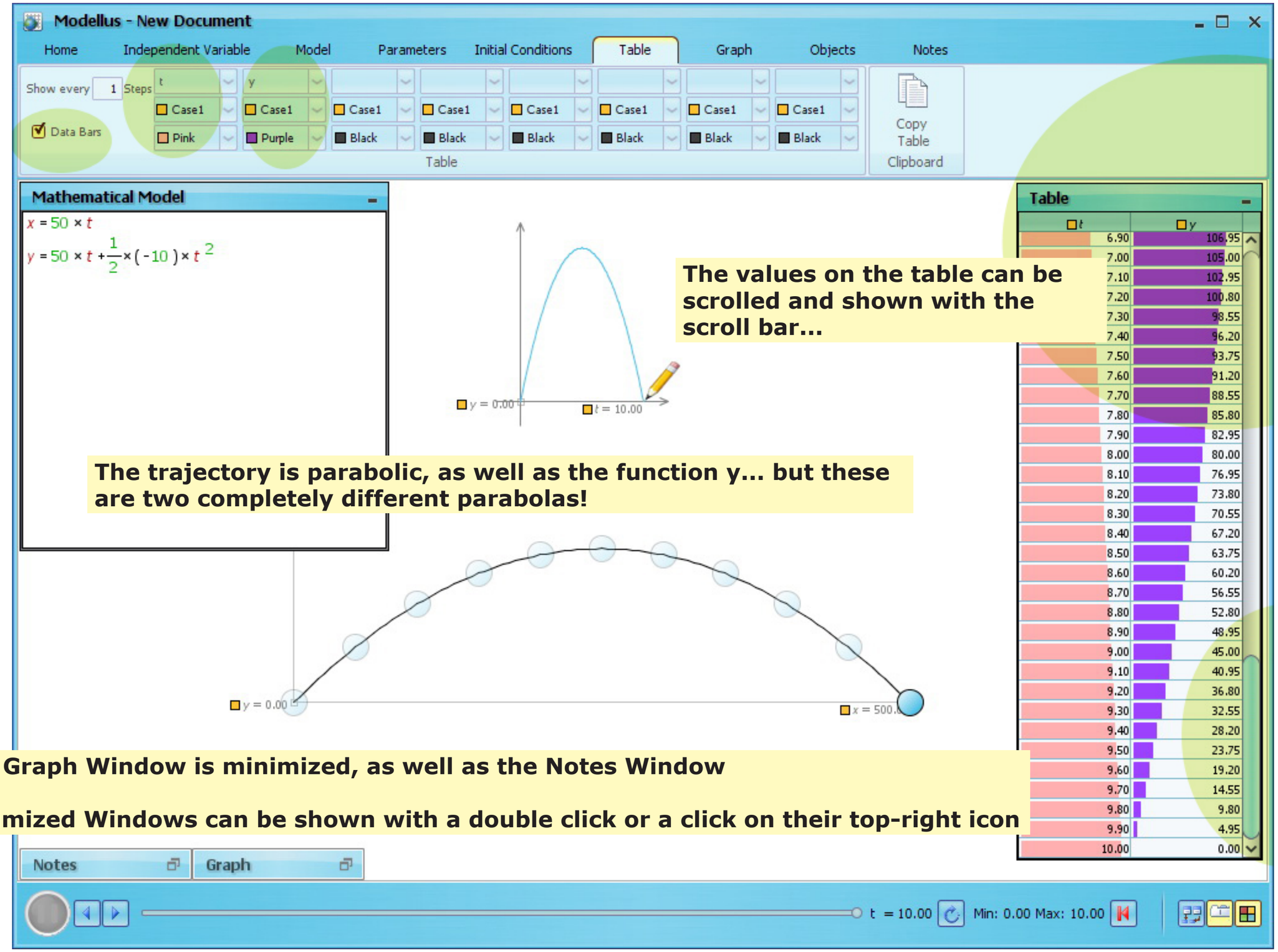
Select the properties for the Pen on the Ribbon

The Horizontal scale was changed to 1 unit = 10 pixels because the default value (1 unit = 1 pixel) was too small...

The Pen can draw points or lines, just select or unselect the Points check-box

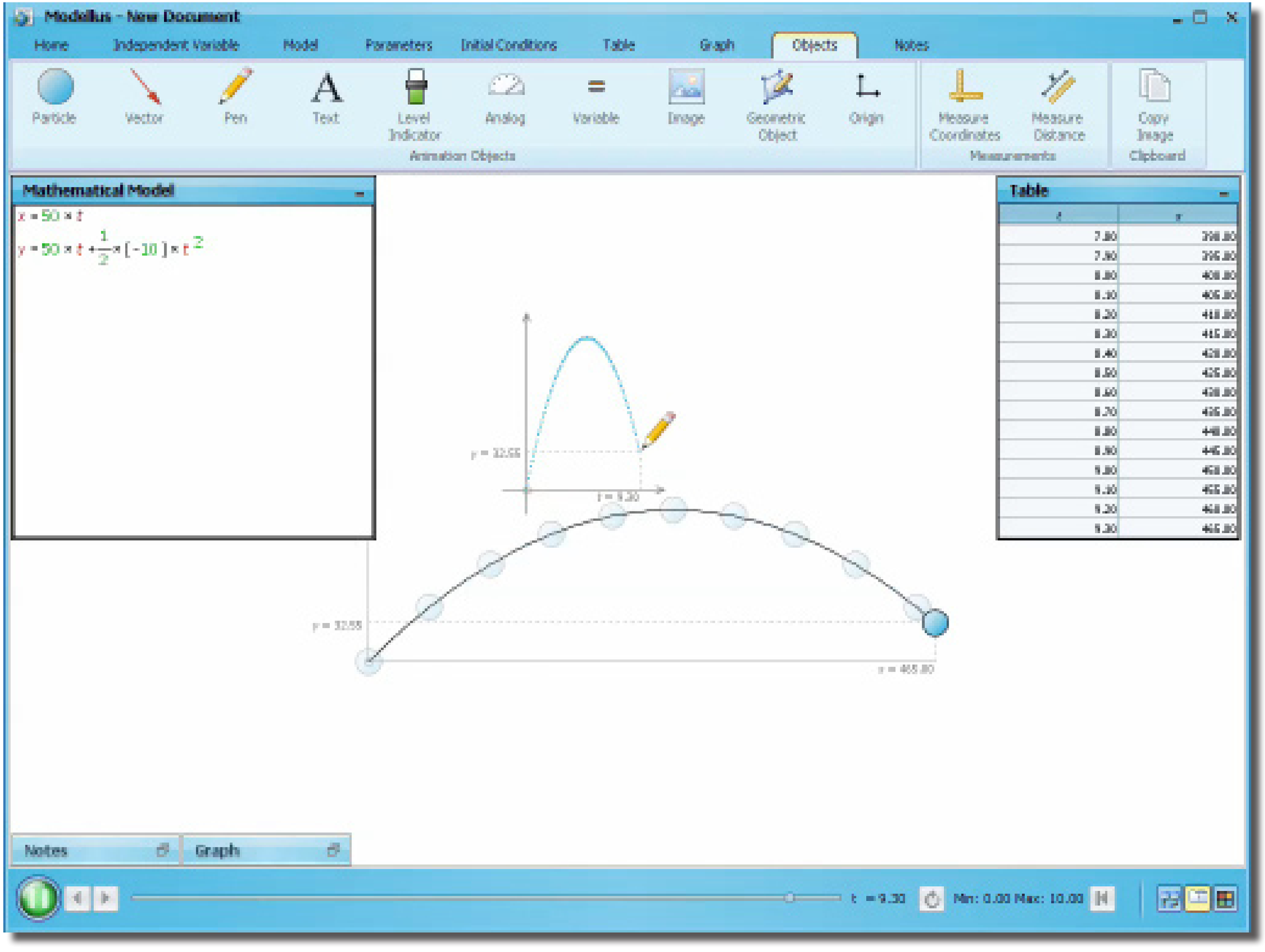
2h See it in action: a simple example with functions (a model of projectile motion)

And the complete model is…



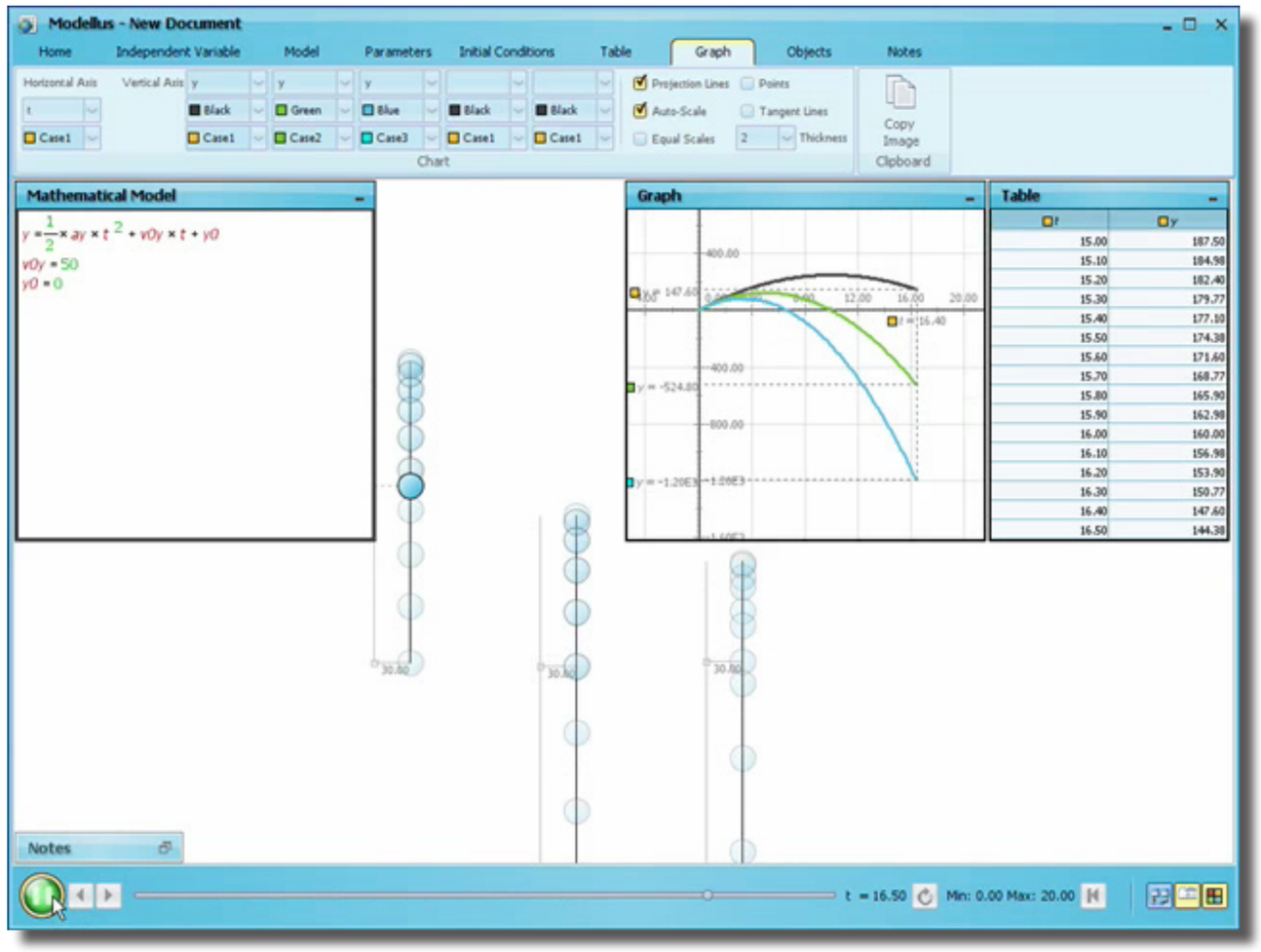
2i See it in action: a simple example with functions (a model of projectile motion)

And now a complete movie on how to make the model...



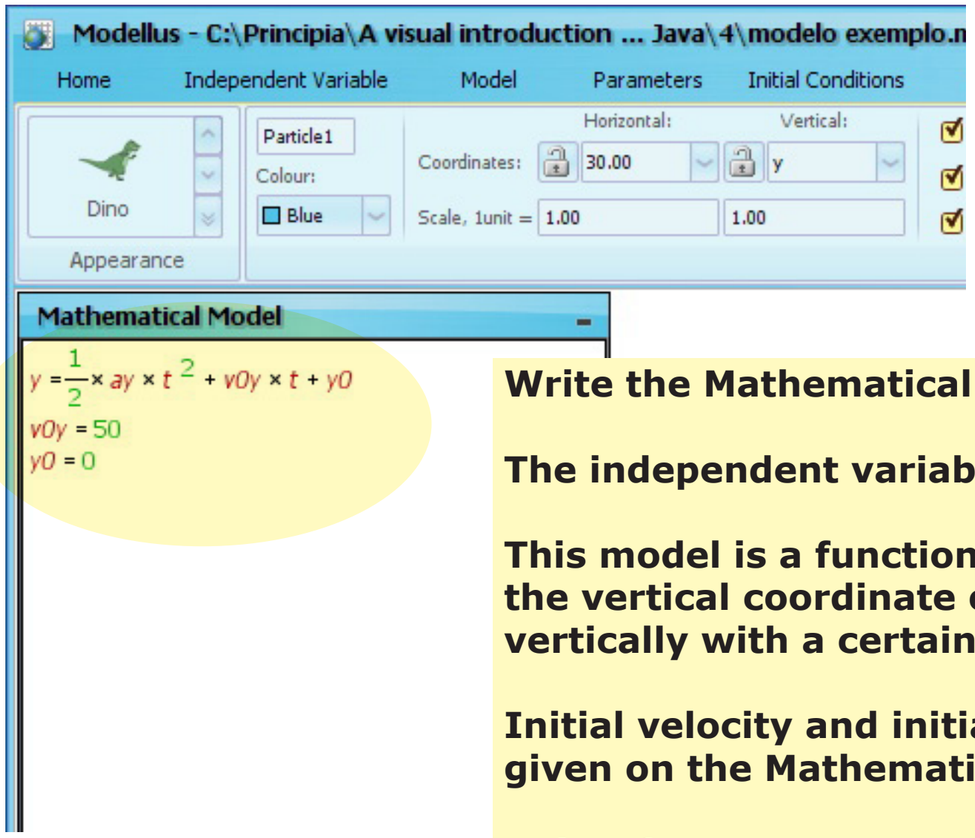
3 A more complex example with functions (exploring parameters)

Particle launched vertically, with different accelerations: what you will get...



3a A more complex example with functions (exploring parameters)

Create the mathematical model...



Write the Mathematical Model...

The independent variable is the time *t*...

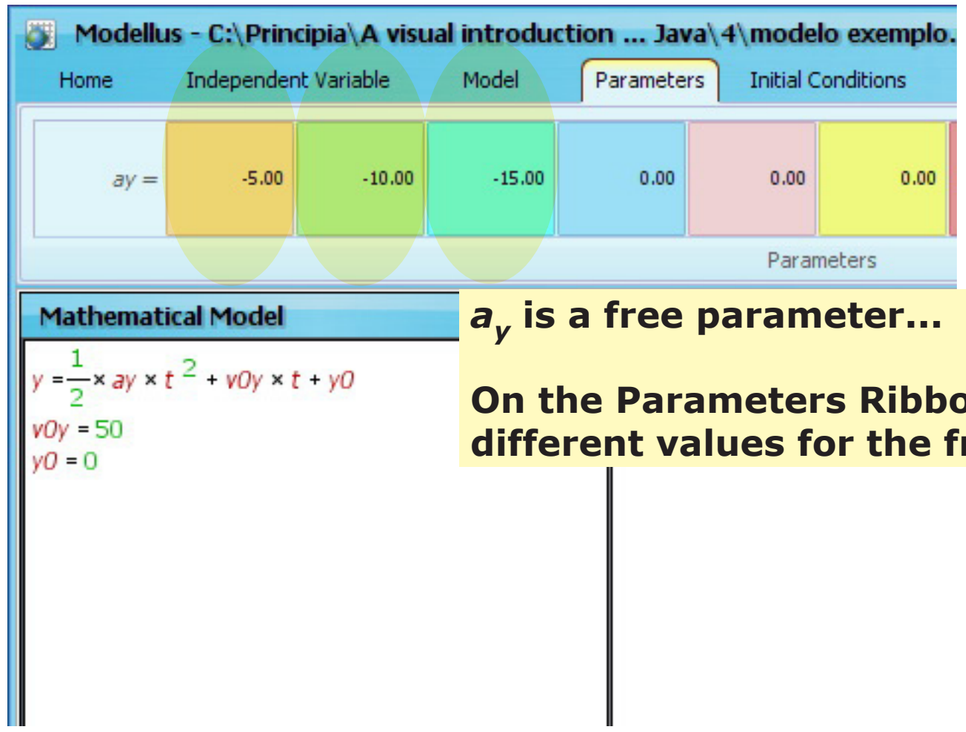
This model is a function *y* that represents the vertical coordinate of a particle launched vertically with a certain initial velocity v_{0y}

Initial velocity and initial coordinate are given on the Mathematical Model Window

a_y is a free parameter...

3b A more complex example with functions (exploring parameters)

Give different values for the free parameter…

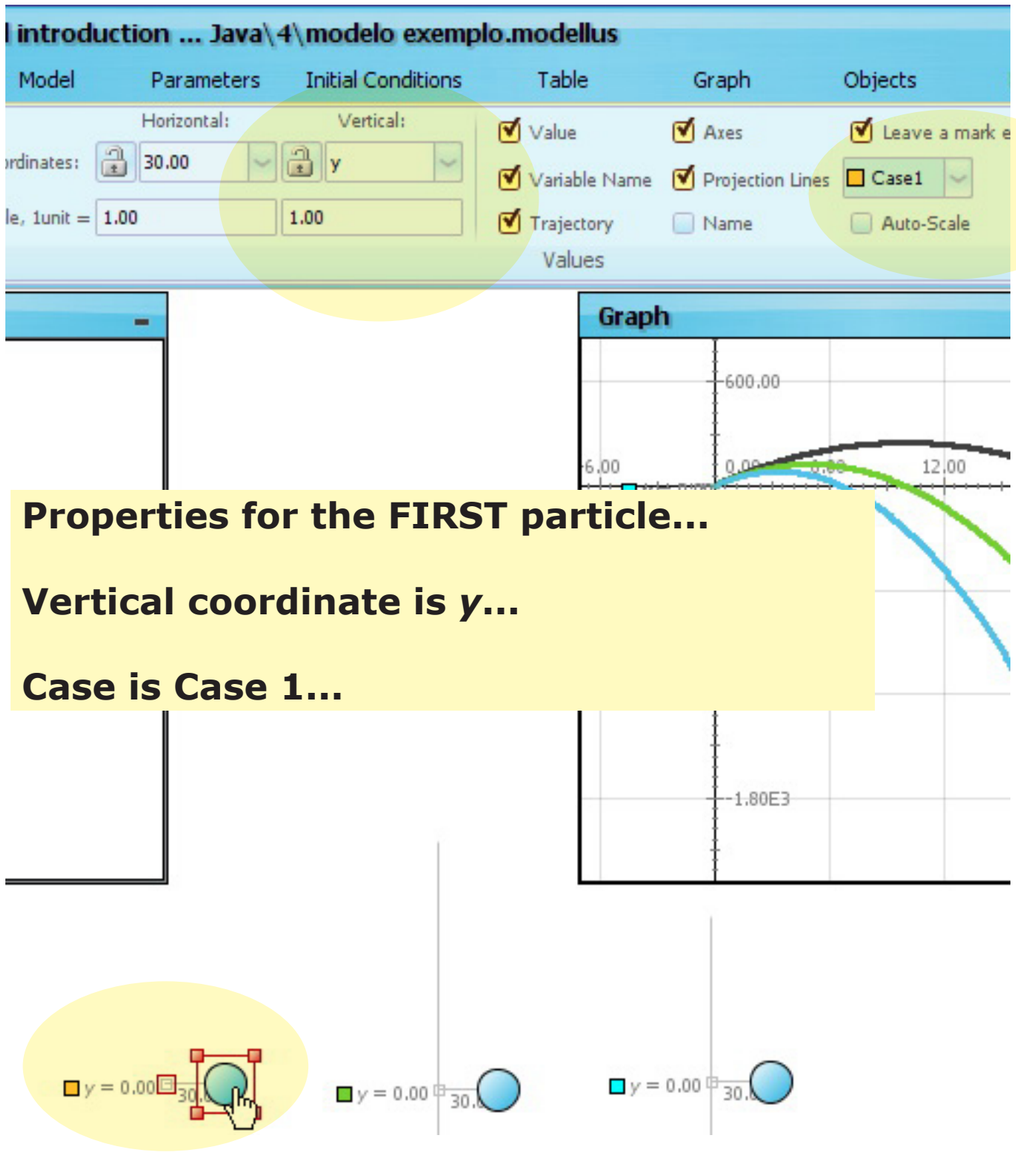


a_y is a free parameter…

On the Parameters Ribbon, give three different values for the free parameter…

3c A more complex example with functions (exploring parameters)

Create three particles and attribute properties for the first particle...



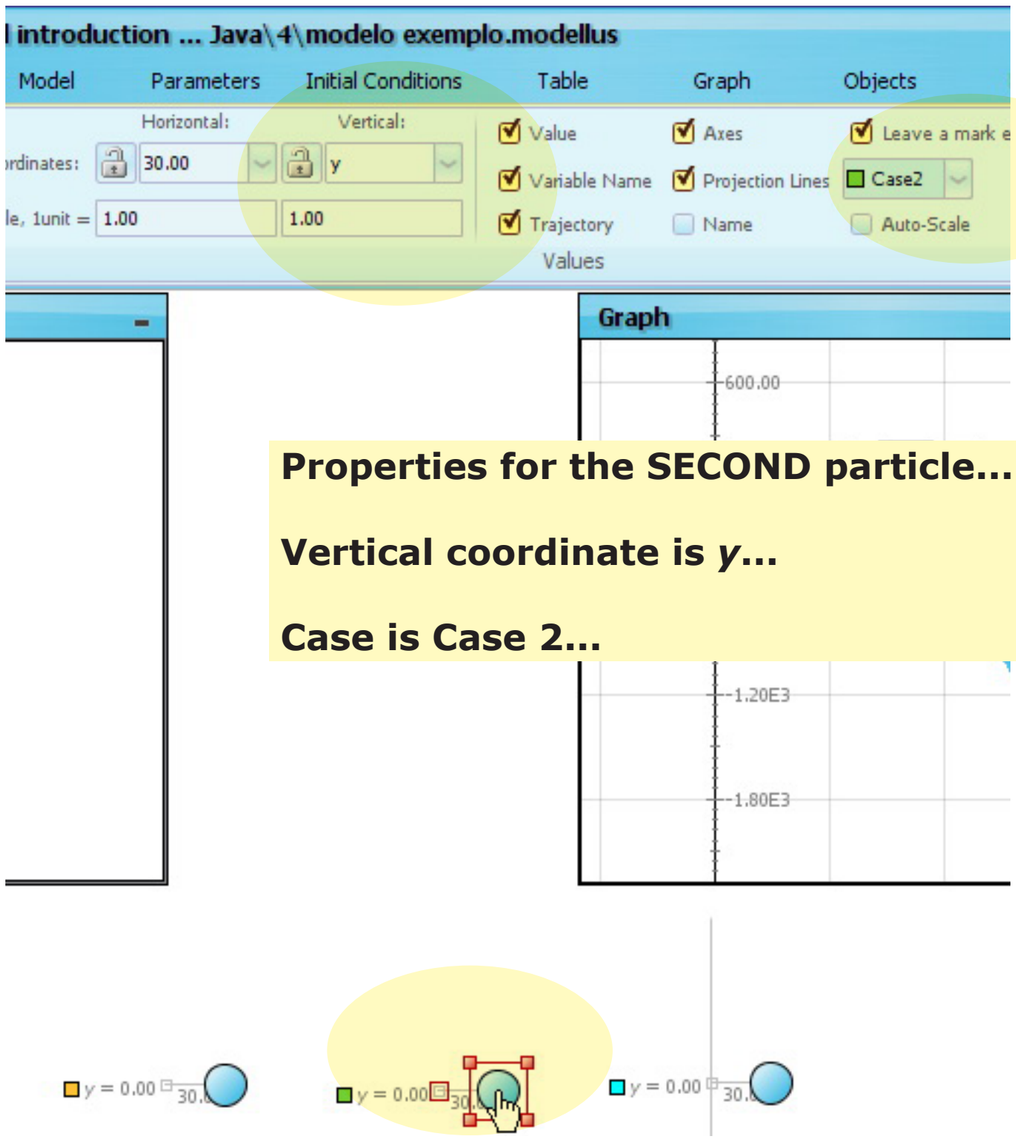
Properties for the FIRST particle...

Vertical coordinate is *y*...

Case is Case 1...

3d A more complex example with functions (exploring parameters)

Attribute properties for the second particle...



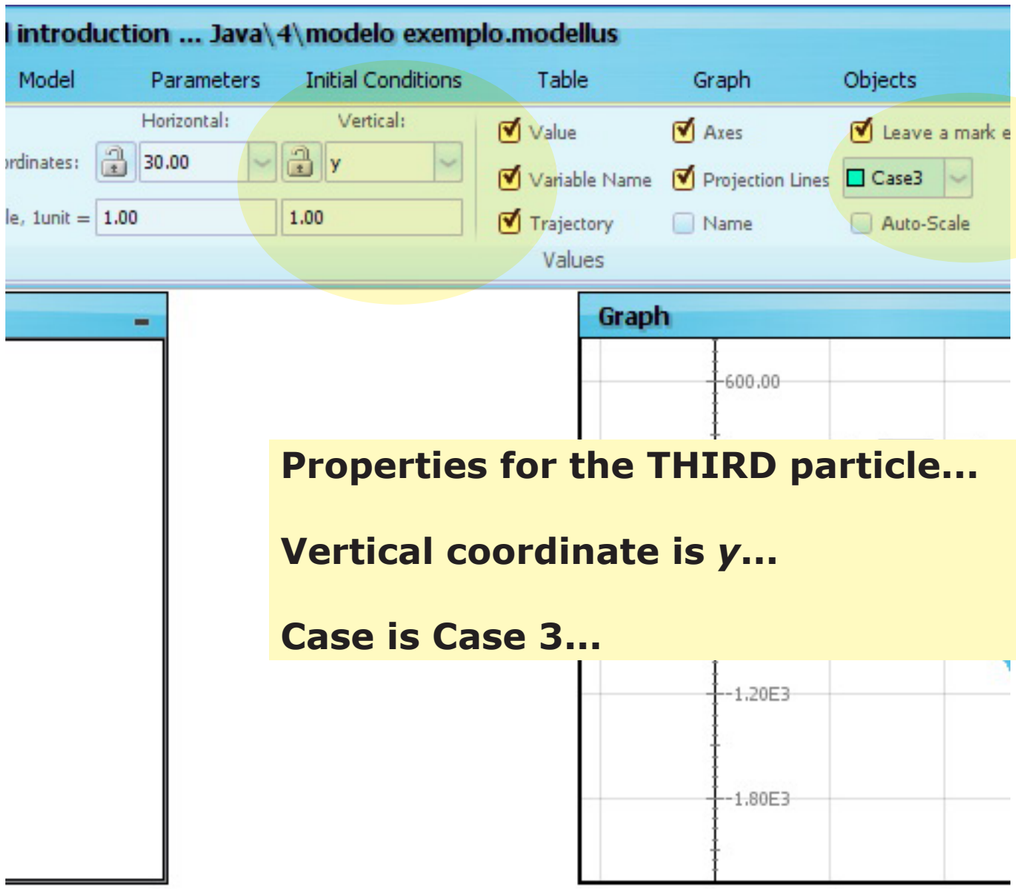
Properties for the SECOND particle...

Vertical coordinate is *y*...

Case is Case 2...

3e A more complex example with functions (exploring parameters)

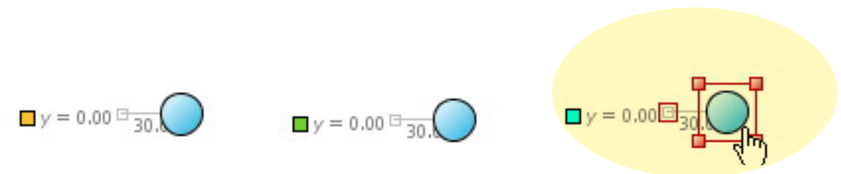
Attribute properties for the third particle...



Properties for the THIRD particle...

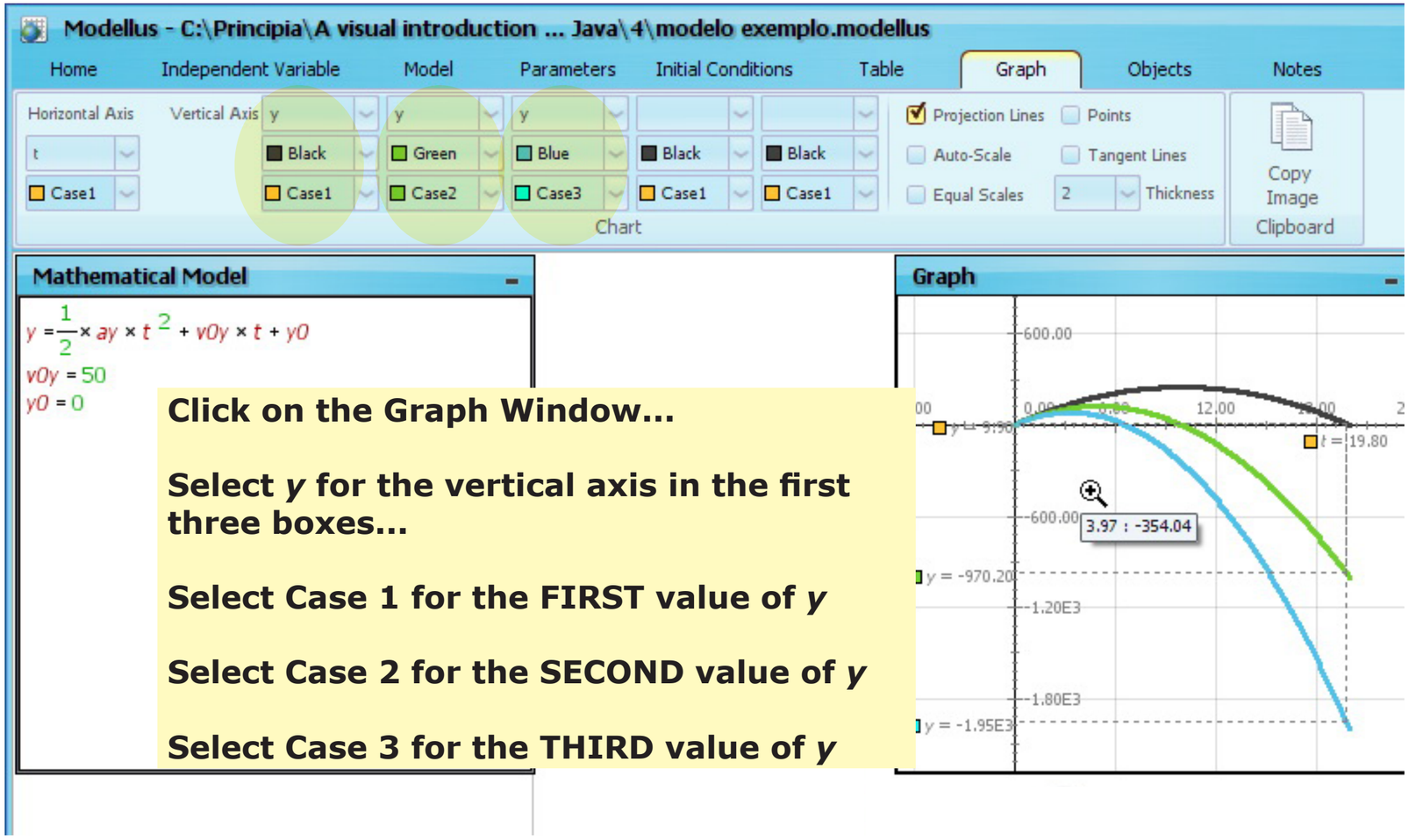
Vertical coordinate is *y*...

Case is Case 3...



3f A more complex example with functions (exploring parameters)

Select what to display on the graph window...



Click on the Graph Window...

Select *y* for the vertical axis in the first three boxes...

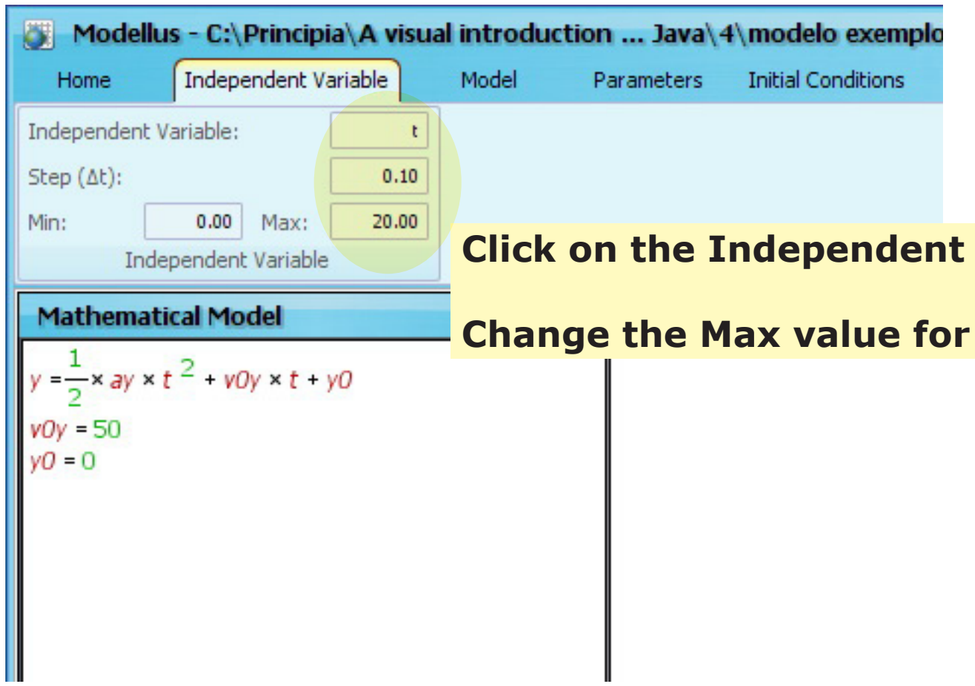
Select Case 1 for the FIRST value of *y*

Select Case 2 for the SECOND value of *y*

Select Case 3 for the THIRD value of *y*

3g A more complex example with functions (exploring parameters)

Change the upper limit for the independent variable…

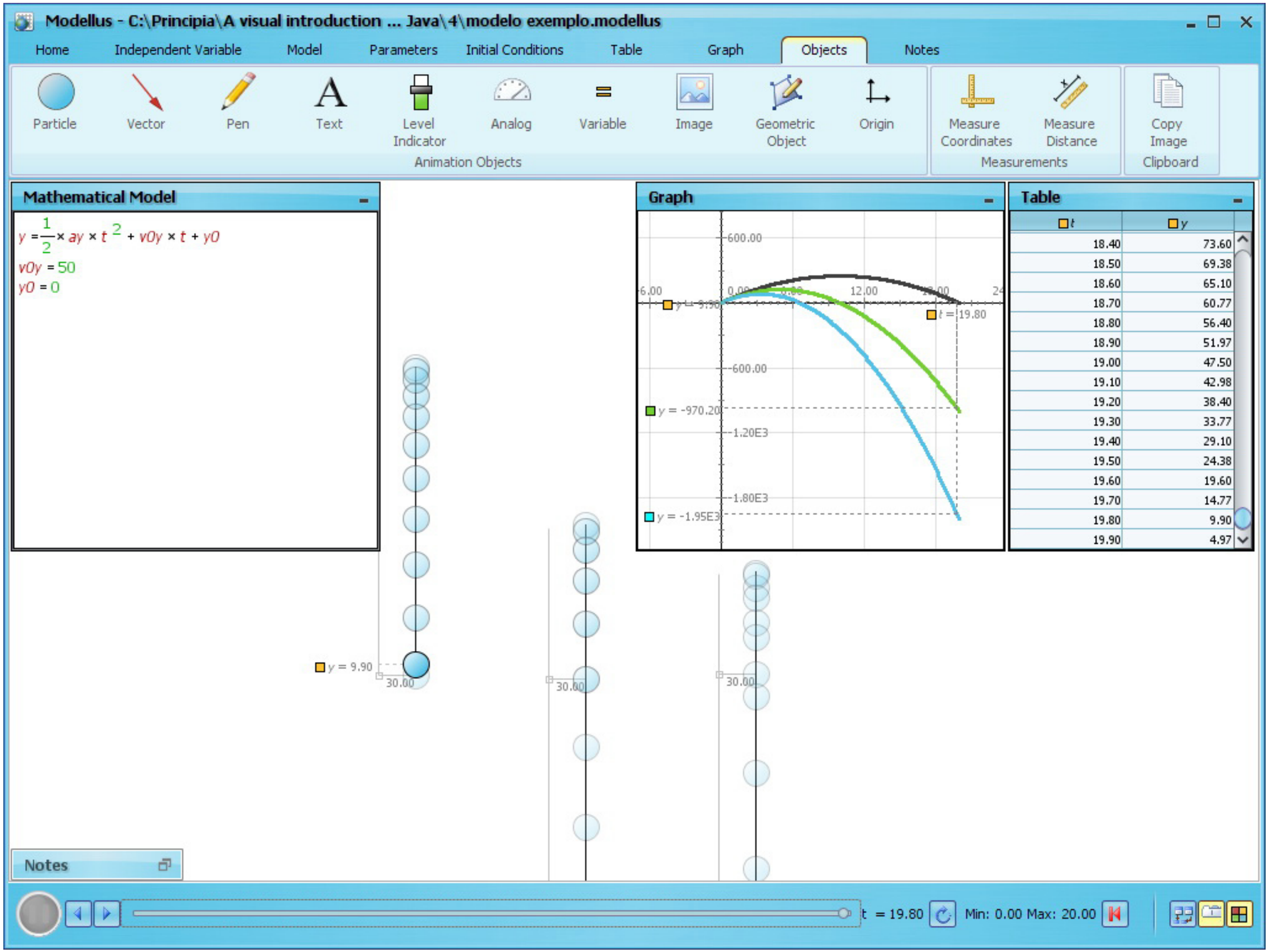


Click on the Independent Variable Ribbon…

Change the Max value for *t*: 20 units is a good value…

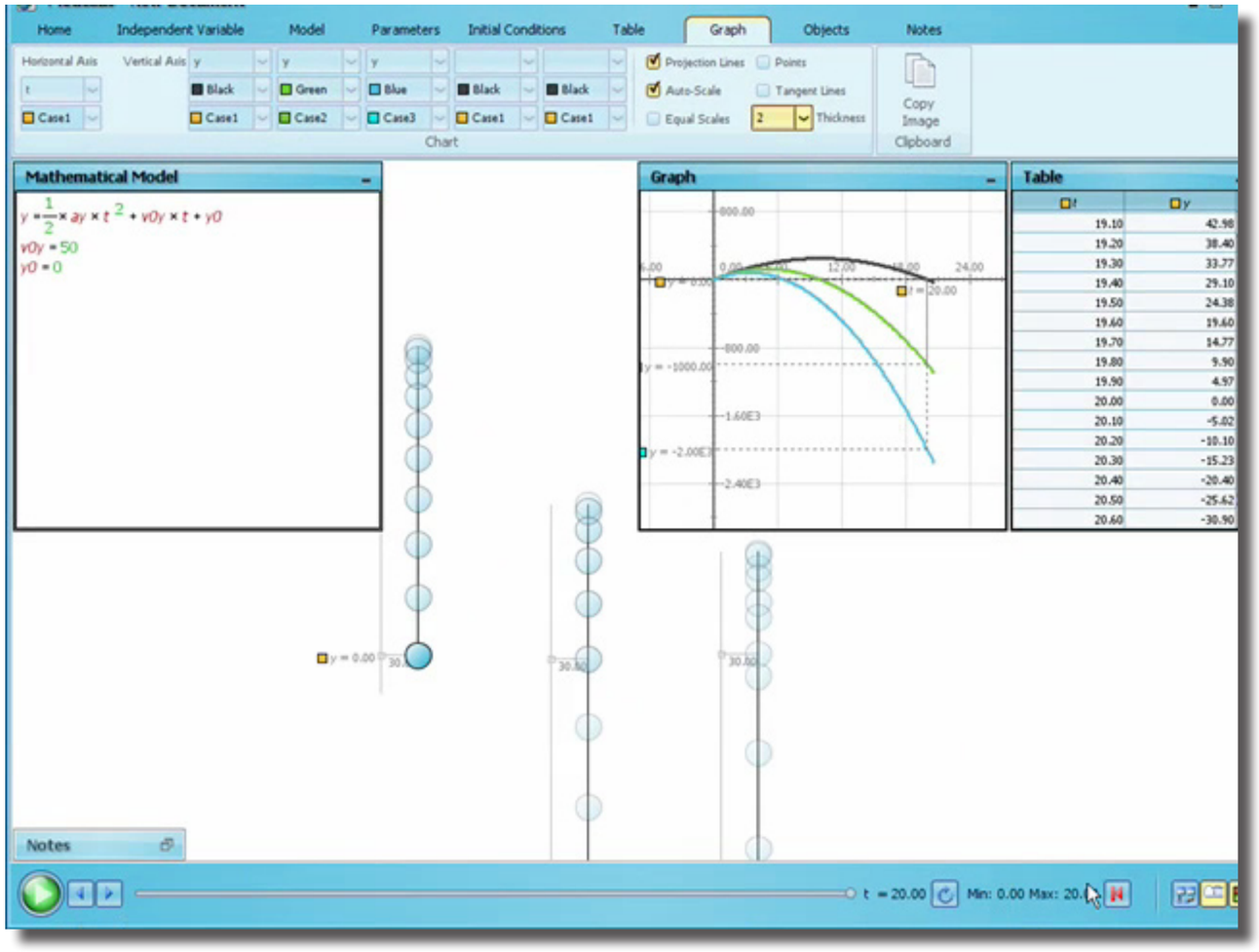
3h A more complex example with functions (exploring parameters)

See it all, as an image...



3g A more complex example with functions (exploring parameters)

See it all, as a movie...



4 Exploring inertia with iterations

See a movie of what you will get...

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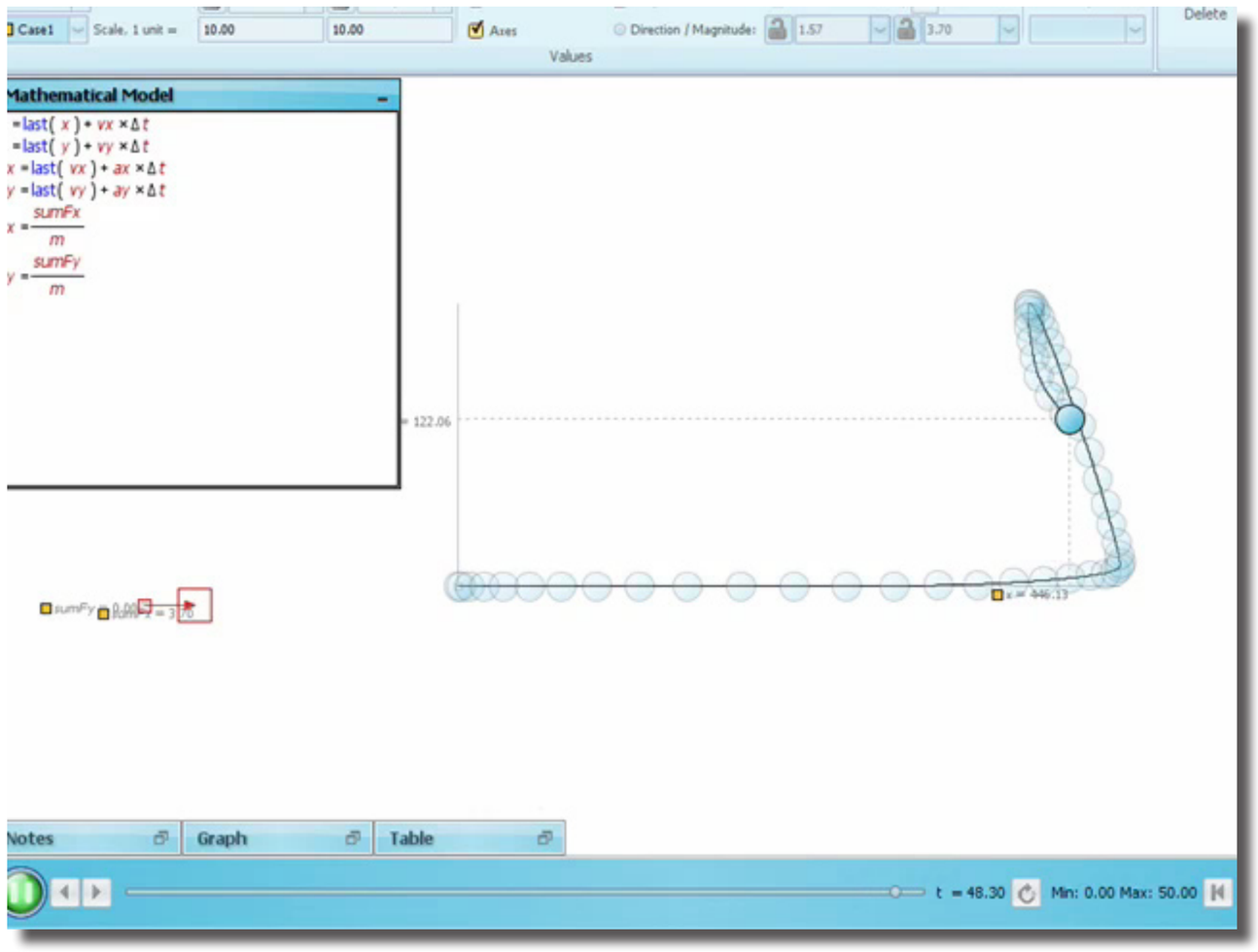
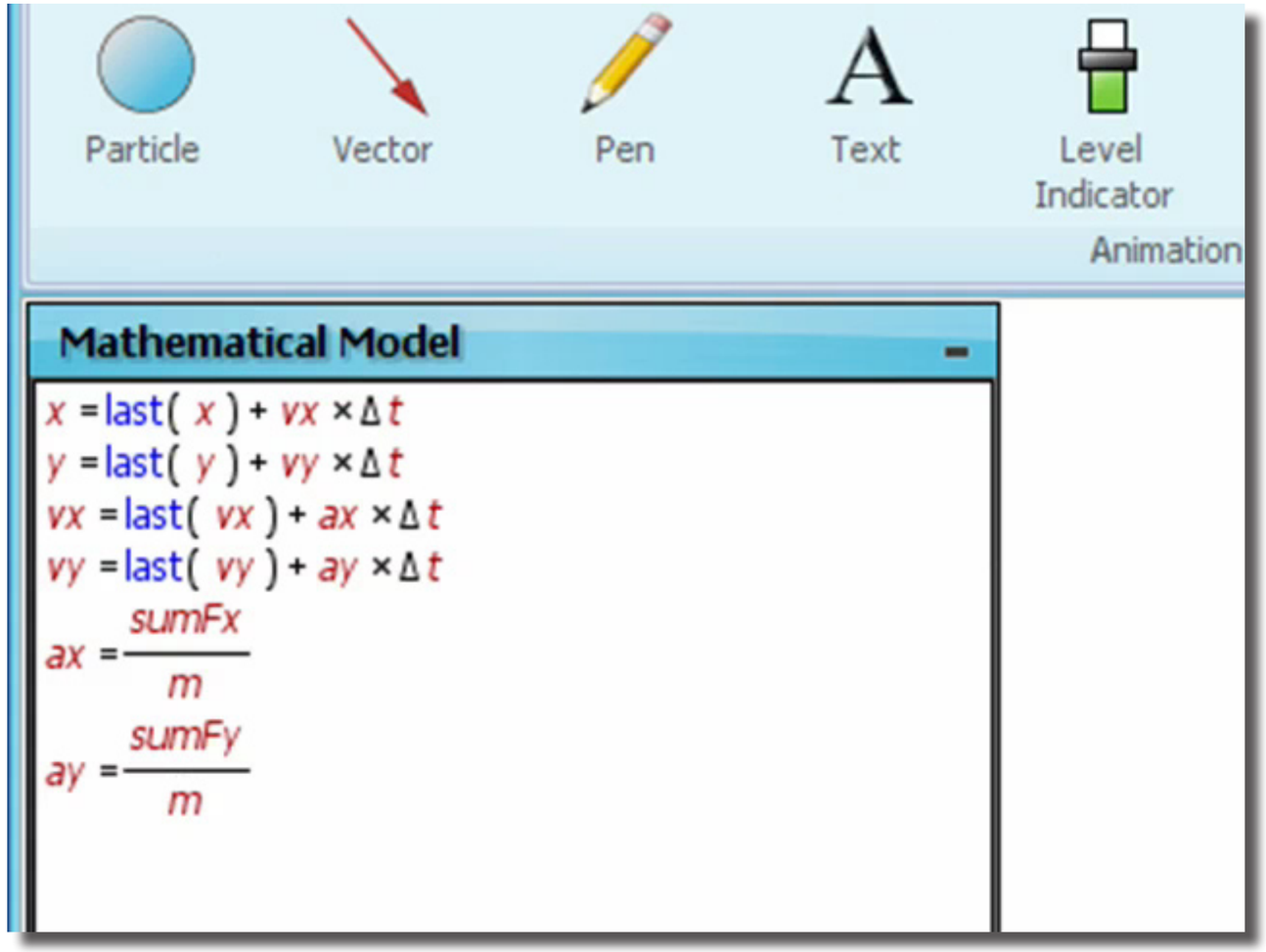


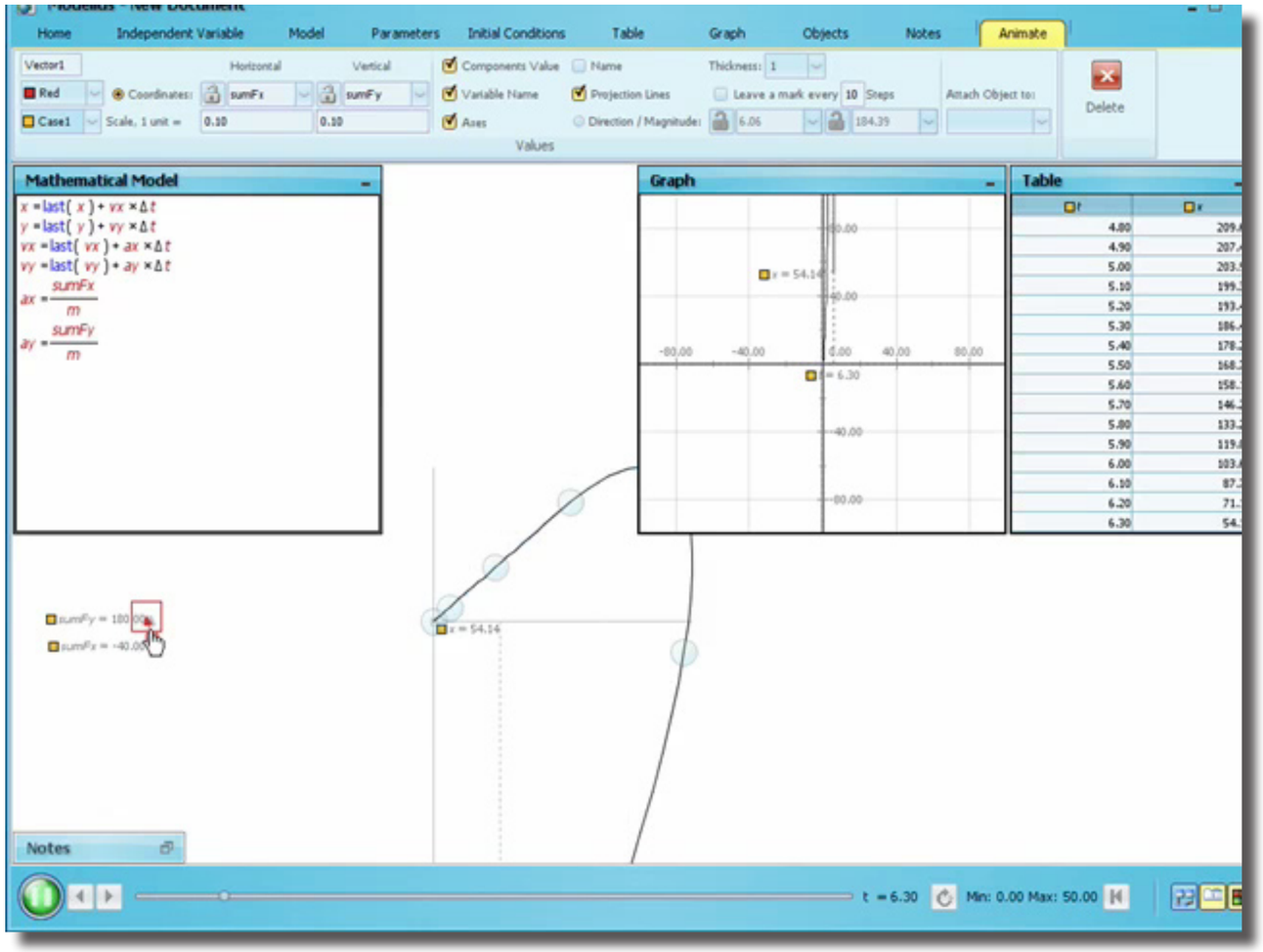
4a Exploring inertia with iterations

Creating the model...



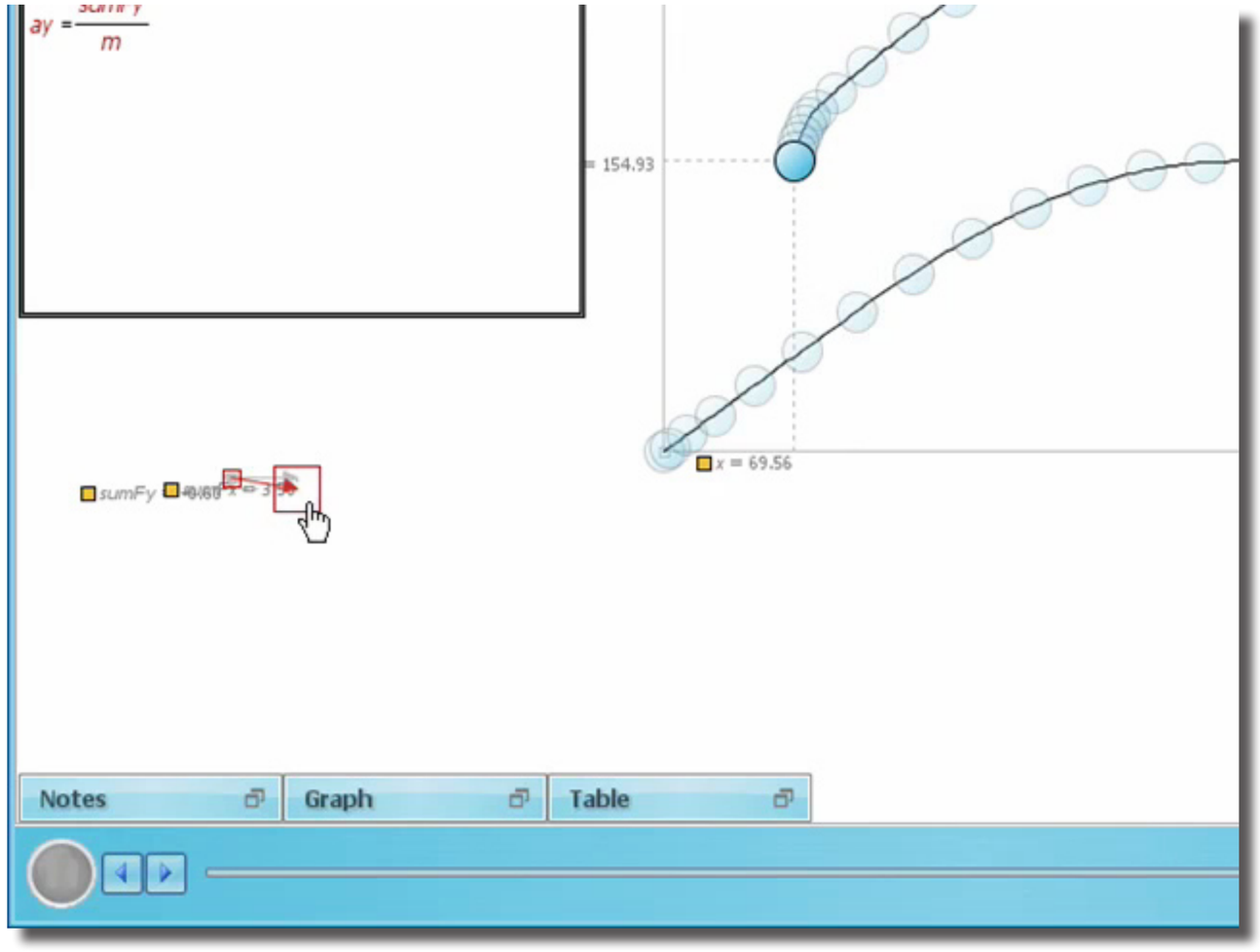
4b Exploring inertia with iterations

Setting the scene... but there is a problem with the scale for the vector sum of the forces!



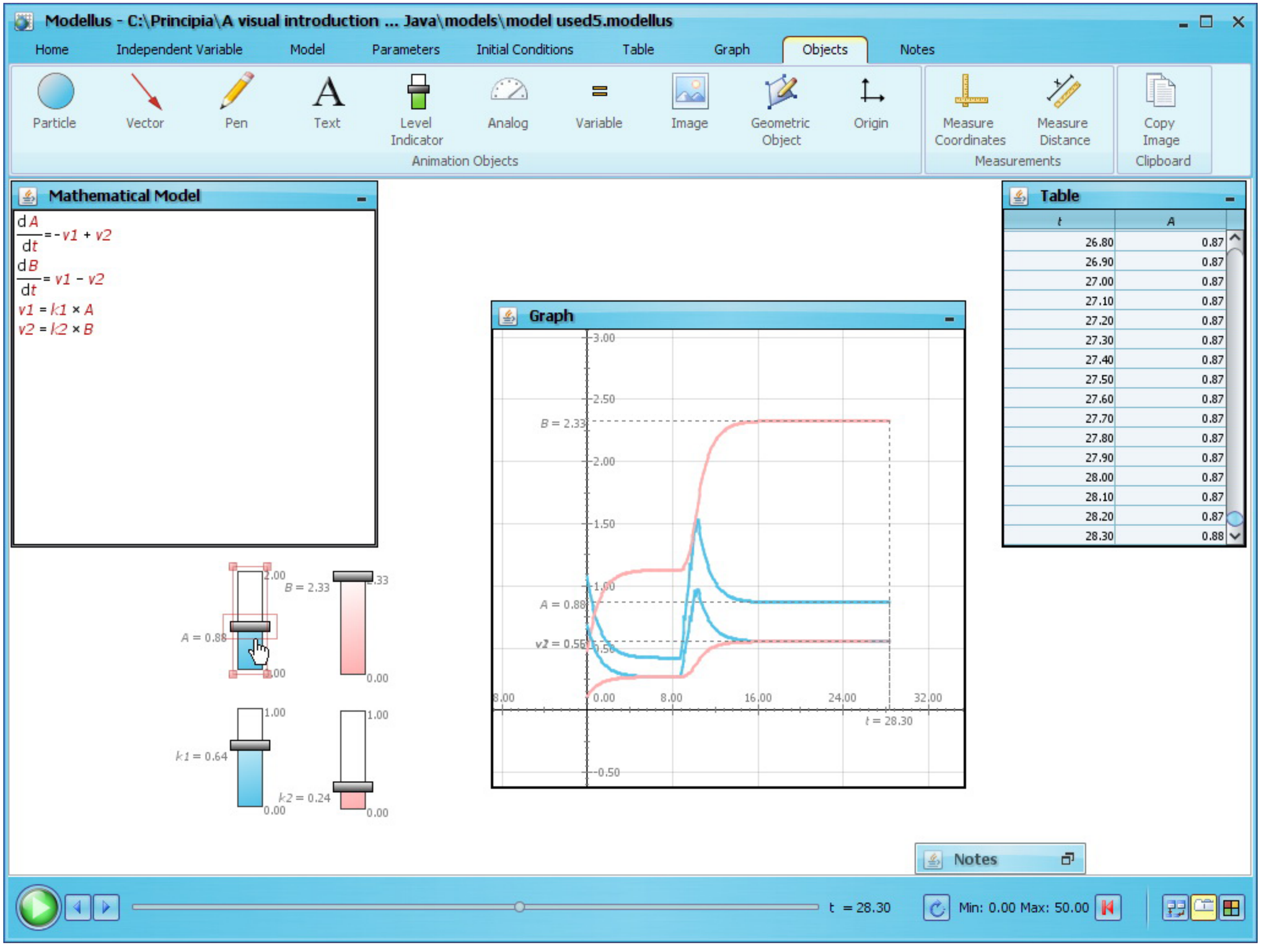
4c Exploring inertia with iterations

Changing the scale for the sumF vector makes it more easy to control velocity...



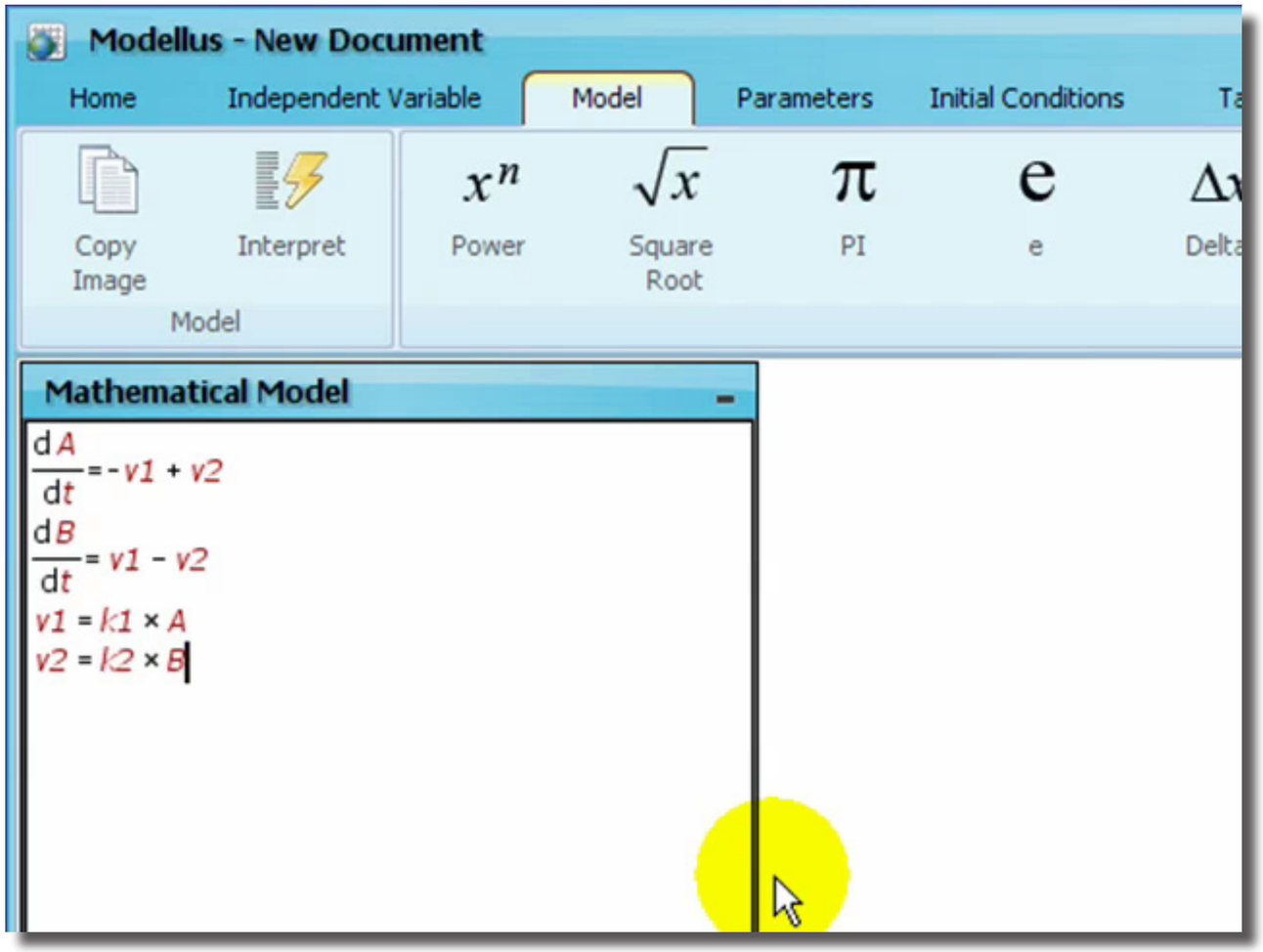
5 Chemical equilibrium with differential equations

The model. The graph shows how the system reacts to change in the concentration of a reactant



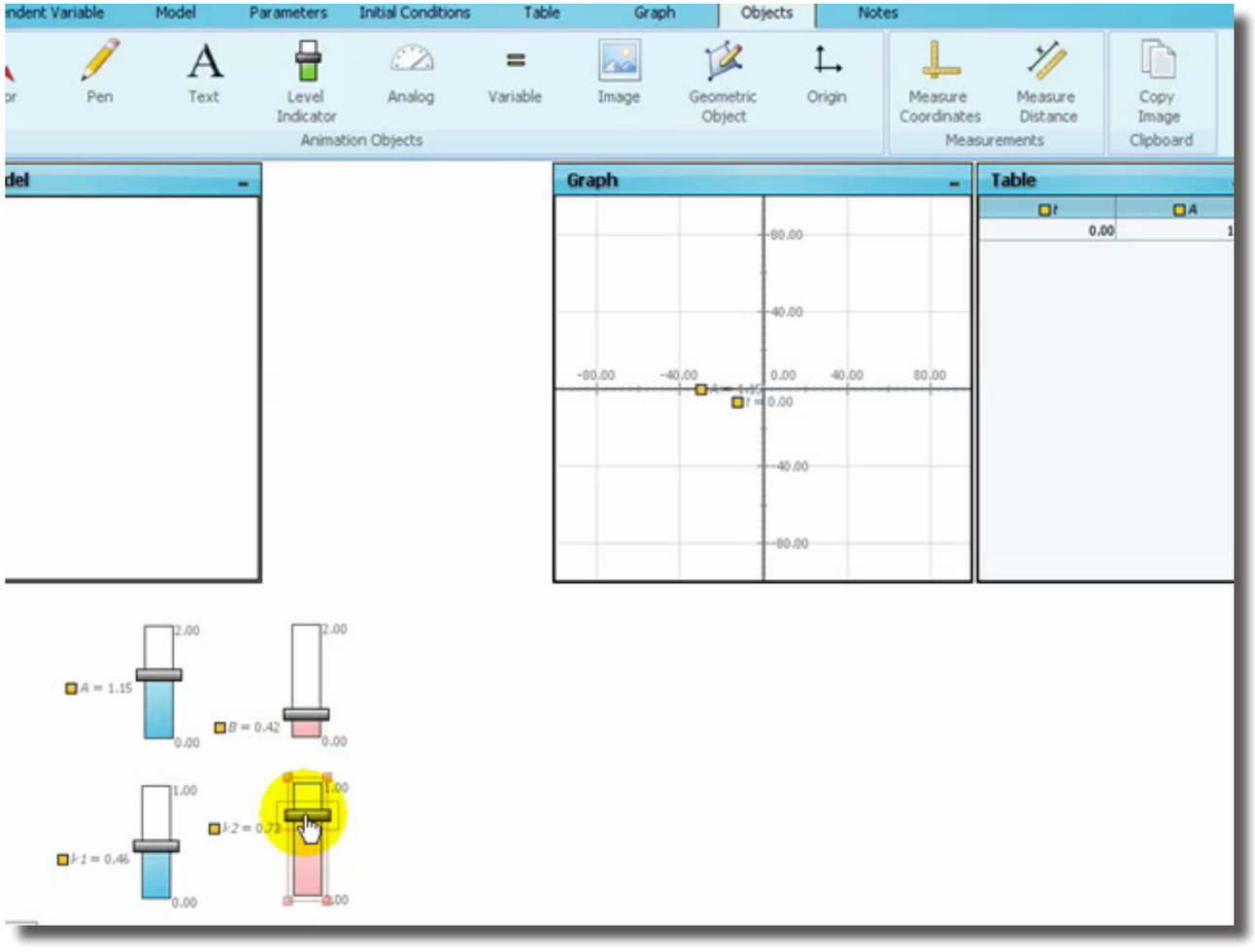
5a Chemical equilibrium with differential equations

Creating the model...



5b Chemical equilibrium with differential equations

Creating controls for initial values and for parameters… and giving values for them



5c Chemical equilibrium with differential equations

Running the model and changing values interactively...