From Chapter 6:

Laboratory: The Pendulum, in Practice

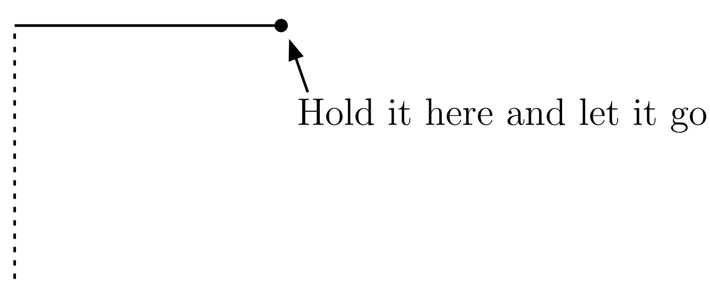
Build a pendulum. Find a blackboard that has a corkboard strip at the top or a hook. Fasten a 3ft length of thread ($l = 3$) to the top of the blackboard and attach a weight (something relatively heavy but compact—a key will do) at the lower end. Hold the weight out at right angles and let it go. Make sure the weight doesn't hit the blackboard. Note the time it takes to make one complete swing. Compare this with the time predicted by the model. Does it take about the same amount of time to go back and forth?

There is one important difference between the model and your pendulum. Your pendulum will "wind down", that is, it will swing less and less as time passes, while the theoretical pendulum keeps swinging as high as ever. The reason the real pendulum winds down is *friction*. This is a form of acceleration. We can add this to our model. Friction is proportional to velocity and is in the opposite direction (it's like the viscous drag you saw in *Falling Rain*). We simply subtract a friction term from v'.

$$
\begin{aligned}
\theta' &= v \\
v' &= -\tfrac{32}{l}\sin(\theta) - kv
\end{aligned}
$$

but what should k be?

Here's one way to find out. Hold the weight out at right angles and let it go.



Mark where it comes back after one complete swing and measure the angle (in radians!). Run the system on an integrator and adjust k until the computer model matches the angle you observed. Now see if this model correctly predicts the height of future swings.

Good luck!