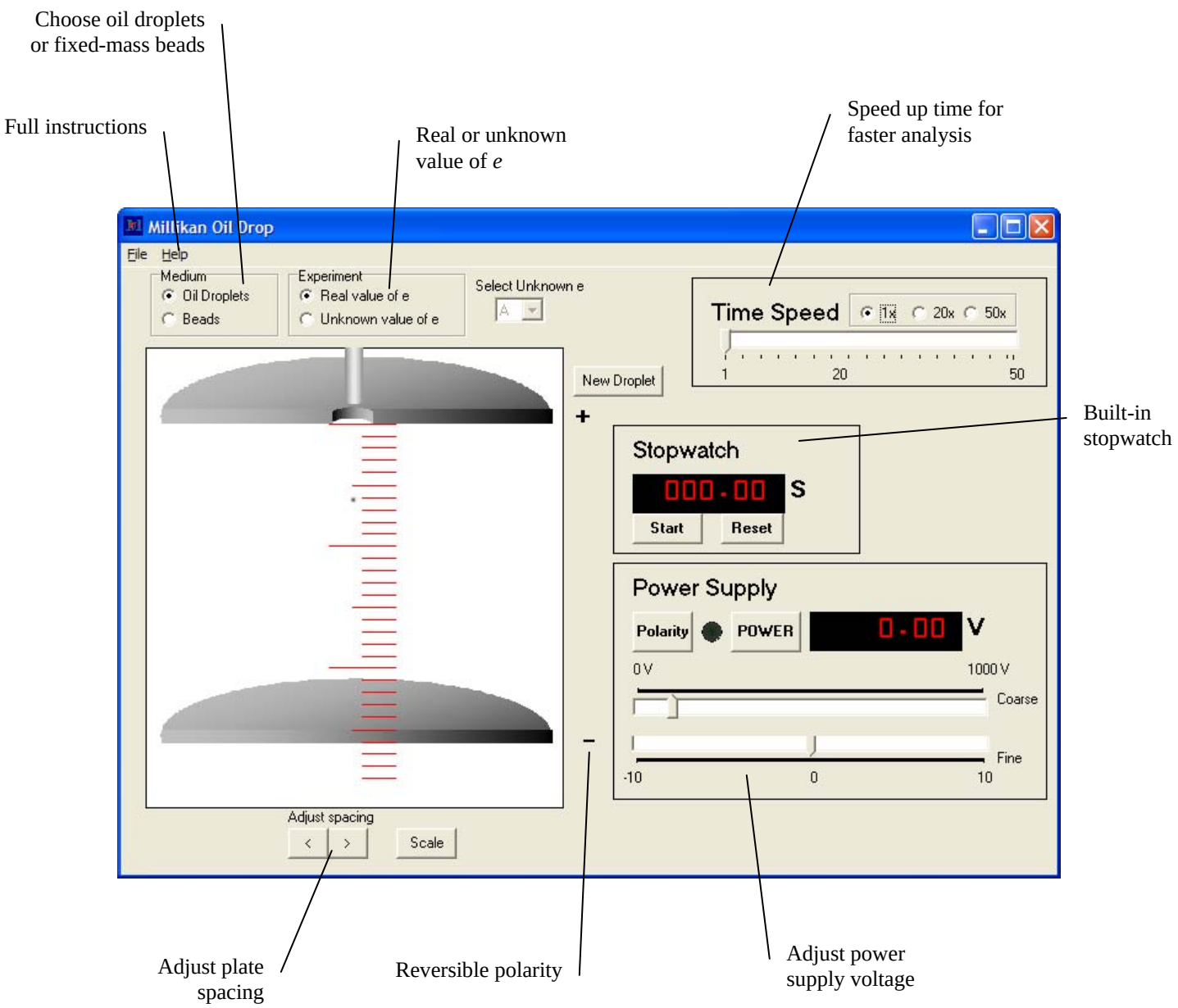
Millikan Oil Drop Apparatus Simulation

This simulation allows you to reproduce Millikan's results, without the mess and expense of a real Millikan apparatus. You can practise your technique on fixed-mass beads beads and move to droplets, and then, using a fictional value for ***e***, reproduce Millikan's data collection and analysis to identify the value. Since the droplets and beads fall very slowly, there is a built in time-lapse mechanism to "speed up" the passage of time. The built in stopwatch – used to time the falling droplets to calculate terminal velocity – is tied in with the time speed. At 712 kB, the program is small enough to take it home and use it on a home computer.



Using the Millikan Oil Drop Simulation

The experiment:

The apparatus for this experiment was developed by Millikan and Fletcher in 1909 to determine the charge of an individual electron. The experiment is both simple and elegant. If a droplet of oil can be suspended between charged plates, then the upward electric force on the droplet exactly matches the downward force of gravity on the droplet. If the mass of the droplet can be found, then the charge on the droplet can be found. This experiment is often performed with microscopic spheres of known mass, but originally the mass of oil droplets was determined by timing the fall of the droplet, and using the density and terminal velocity to find the mass. Either method may used in this simulation.

Why use a simulation?

Performing this experiment in the classroom or lab using real equipment is daunting for many instructors. It is time consuming to perform the experiment and the high voltage can be dangerous. In addition, the equipment must be cleaned and maintained. Using the simulation, set up and clean up times are non-existent, and there is no danger of electrocution. In this simulation, students still need to make all measurements and calculations in order to determine the values.
An extra feature of this simulation is that time may be accelerated in order to speed up observations of motion, as the terminal velocity of the miniscule droplets is very slow.

Modes

There are to modes for running the experiment. Using the correct, real world value of ***e*** (the fundamental charge), students may use either beads (microspheres of fixed mass) or oil droplets (mass must be determined by finding the terminal velocity) to determine the number of excess electrons on the particle. When the mode is switched to ‘Unknown value of e’, the program uses an alternate value for the fundamental charge. Students use beads or oil drops to determine that charge, just as Millikan and Fletcher did. All unknown values of ***e*** are close to the real value. These values are known to the author, but not made public – so nobody can cheat. Students using this for a lab must collect enough evidence to make a valid argument, and the instructor will have to gauge the result by the quality of the data and presentation, not by accuracy. In other words, instructors can’t “cheat” either.

Further instructions are provided in the HELP file in the program itself.