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A Binary System

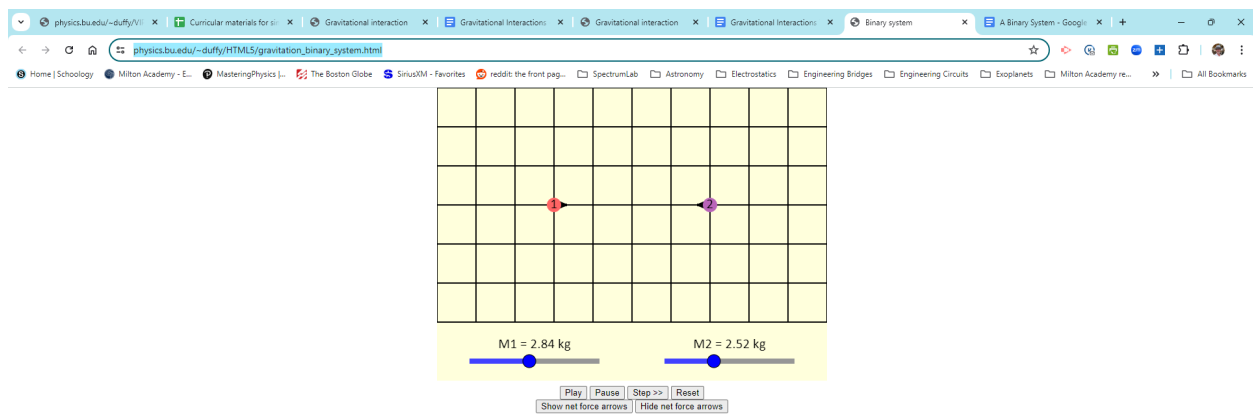
Demonstrating the time evolution of two masses attracting each other

KEY DEFINITIONS:

- **Orbit:** the path through space a body makes when exposed to some gravitational force.
- **mass**

Link to the simulation: [Binary system](https://physics.bu.edu/~duffy/sims.html)

1. Load the simulation “Binary system”. It can be found at the link above or in the collection of simulations here: [https:// physics.bu.edu/~duffy/sims.html](https://physics.bu.edu/~duffy/sims.html) under “Gravitation” in the sidebar.




A binary system

This is a binary system. The velocities of the two objects are initially equal-and-opposite (object 1's velocity directed down and object 2's directed up). You might expect them to have repeating orbits, but can you explain why there is often a drift of the orbits in one direction or another? And when would you expect no drift?

Note that occasionally the objects get a bit too close and the simulation does not handle the physics with enough accuracy to really reproduce the orbits accurately.

Simulation written by Andrew Duffy, and first posted on 5-12-2018.

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2. Try the “Play”, “Pause”, “Reset” buttons.
3. Why do the objects drift upwards or downwards?

4. When are the objects moving fastest? Slowest?
5. When are the force vectors greatest? Least?
6. When are the objects speeding up? When are they slowing down?
7. Student One says "I notice the objects are moving fastest when they are closest. The greater force must be the cause." Student Two says, "I'm not so sure. While it is true that the speed is greatest when the force is greatest, this high speed is due to the time it spent 'falling inwards'. With whom do you agree and why?"
8. Try to imagine the velocity vectors of each object as they move. They will be tangential to the orbits. How are the velocity vectors related to the force vectors?
9. Can you find a pair of times/positions when the magnitude of the force on one object are the same?
10. What simplifying assumptions were made in the design of this simulation?

This worksheet was created by Jim Kernohan of Milton Academy at the AAPT Summer Meeting '24 in July, 2024.