# 13.5: Flash Animations for Physics

We have been increasingly using Flash animations for illustrating Physics content. This page provides access to those animations which may be of general interest. The animations will appear in a separate window.

The animations are sorted by category, and the file size of each animation is included in the listing. Also included is the minimum version of the Flash player that is required; the player is available free from http://get.adobe.com/flashplayer/. The categories are:

- Chaos
- Classical Mechanics
- Electricity and Magnetism
- Fluid Mechanics
- Micrometer Caliper
- Miscellaneous
- Nuclear
- Optics
- Oscilloscope
- Quantum Mechanics
- Relativity
- Sound Waves
- Vectors
- Waves

In addition, I have prepared a small tutorial in using Flash to do Physics animations. It contains screen shots and embedded Flash animations, so the file size is a 173k. You may view it in a separate window at http://faraday.physics.utoronto.ca/PVB/Harrison/Flash/Tutorial/FlashPhysics.html.

Links to versions of these animations in other languages, other links, and license information appear towards the bottom of this page.

## The Animations

There are 99 animations listed below. Some are simple; others are more complex. The most recent animations added to the list are identified.

| Category | Title | Description/Comment | |
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| Chaos | Bunimovich Stadium | Illustrating the chaotic Bunimovich Stadium. Requires Flash 6; file size is 17k. | View |
| Chaos | Logistic Map | The logistic map, which demonstrates the bifurcation of the population levels preceding the transition to chaos. Requires Flash 6; file size is 15k. | View |
| Chaos | Lorenz Attractor | Looking at the Lorenz Attractor in a chaotic regime, allowing the attractor to be rotated. Requires Flash 6; file size is **550k**. | View |
| Chaos | Three-body Gravitational Interaction | 2 fixed suns and 1 planet. Initial conditions are controllable, and up to 4 different independent planets may be displayed. Requires Flash 6 and a computer with reasonable power; file size is 50k. | View |
| Classical Mechanics | Displacement and Distance | A simple animation showing the difference between the *distance* and the *displacement*. Requires Flash 5; file size is 5k. | View |
| Classical Mechanics | Constant Acceleration | 1-dimensional kinematics of a body undergoing constant acceleration. Includes visually integrating the acceleration and velocity graphs, and visually differentiating the position and velocity graphs. Requires Flash 6; file size is 30k. | View |
| Classical Mechanics | Motion Animation | A car with a non-zero initial speed has a constant acceleration whose value can be controlled by the user. Requires Flash 6; file size is 27k. | View |

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| Classical Mechanics | Dropping Two Balls Near the Earth's Surface | Two balls falling near the Earth's surface under the influence of gravity. The initial horizontal speed of one of the balls may be varied. Requires Flash 6; file size is 11k. | View |
| Classical Mechanics | Galilean Relativity | Illustrating Galilean relativity using his example of dropping a ball from the top of the mast of a sailboat. Requires Flash 6; file size is 22k. | View |
| Classical Mechanics | Foucault Pendulum | A simple animation viewing a Foulcault Pendulum at the North Pole from an inertial frame above the Earth. See also the Foucault Pendulum animation in the Relativity section. Requires Flash 7 and Action Script 2; file size is **1.3 M** . | View |
| Classical Mechanics | Projectile Motion | Firing a projectile when air resistance is negligible. The initial height and angle may be adjusted. Requires Flash 6; file size is 36k. | View |
| Classical Mechanics | Kinematics of Projectile Motion | A visualization exploration of the kinematics of projectile motion. Requires Flash 6; file size is 9k. | View |
| Classical Mechanics | The Monkey and the Hunter | An animation of the classic lecture demonstration. The actual demonstration is preferable if possible; then this animation can be given to the students for later review. Requires Flash 6; file size is 21k. | View |
| Classical Mechanics | Racing Balls | Two balls roll down two different low-friction tracks near the Earth's surface. The user is invited to predict which ball will reach the end of the track first. This problem is difficult for many beginning Physics students. Requires Flash 6 Release 79; file size is 140k. | View |
| Classical Mechanics | Racing Skiers | The "Racing Balls" animation which is accessed via the above line sometimes triggers cognitive dissonance and rejection in beginning students. For some of these, changing the balls to skiers helps to clarify the situation, and that is what this animation does. The "Racing Balls" one should be used with students first. Requires Flash 6 Release 79; file size is 145k. | View |
| Classical Mechanics | Air Track Collisions | Elastic and inelastic collisions on an air track, with different masses for the target cart. Requires Flash 6; file size is 70k. | View |
| Classical Mechanics | Newton's Cradle | A small animation of Newton's Cradle, sometimes known as Newton's Balls. Requires Flash 6; file size is 1k. | View |
| Classical Mechanics | Hooke's Law | A simple animation illustrating Hooke's Law. Requires Flash 6; file size is 13k. | View |
| Classical Mechanics | Coordinate System for Circular Motion | An unusual coordinate system for describing circular motion. Requires Flash 6; file size is 94k. | View |
| Classical Mechanics | Vertical Circular Motion | A mass is in circular motion in the vertical plane. We show the weight and force exerted by the tension in the string. Requires Flash 6; file size is 7k. | View |
| Classical Mechanics | Forces on a Pendulum | The weight, force due to tension, and total force exerted on the bob of a pendulum are shown. Requires Flash 6; file size is 8k. | View |

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| Classical Mechanics | Motion in a Non-inertial Frame | The motion of a ball in uniform circular motion is viewed by an observer in a rotating reference frame. Requires Flash 6; file size is 12j, | View |
| Classical Mechanics | Rolling Disc | A simple animation that traces the motion of a point on a rolling disc. Requires Flash 6; file size is 31k. | View |
| Classical Mechanics | Right-Hand Screw Rule | The direction of the angular velocity vector given by a right-hand screw rule. Requires Flash 6; file size is 196k. Also linked to from the *Vectors* section. | View |
| Classical Mechanics | Direction of the Angular Velocity Vector | A simple animation of the direction of the angular velocity vector. Requires Flash 6; file size is 125k. | View |
| Classical Mechanics | Curling | Curling rocks and tori sliding across surfaces. Requires Flash 6; file size is **601k**. | View |
| Classical Mechanics | How Does a Cat Land on its Feet? | The saying is that cats always land on their feet. This animation explains how they do this. Requires Flash 6; file size is 81k. | View |
| Classical Mechanics | Precession of a Spinning Top | A simple animation of a spinning top which precesses. Requires Flash 5; file size is **739k.** | View |
| Classical Mechanics | Simple Harmonic Motion I | Demonstrating that one component of uniform circular motion is simple harmonic motion. Requires Flash 6; file size is 10k. | View |
| Classical Mechanics | Simple Harmonic Motion II | Illustrating and comparing Simple Harmonic Motion for a spring-mass system and for a oscillating hollow cylinder. Requires Flash 5; file size is 20k. | View |
| Classical Mechanics | Damped Simple Harmonic Motion | The damping factor may be controlled with a slider. The maximum available damping factor of *100* corresponds to critical damping. Requires Flash 6; file size is 12k. | View |
| Classical Mechanics | Driven Simple Harmonic Motion | A harmonic oscillator driven by a harmonic force. The frequency and damping factor of the oscillator may be varied. Requires Flash 6; file size is 199k. | View |
| Classical Mechanics | Coupled Harmonic Oscillators | Two simple pendulums connected by a spring. The mass of one of the pendulums may be varied. Within mathematical rounding errors, the resolution on the screen of one pixel, and a frame rate of 12 frames per second the animation is correct, not an approximation. Requires Flash 6; file size is 47k. | View |
| Electricity and Magnetism | Coulomb's Law | A simulation of an experiment to determine the dependence of the electrostatic force on distance. Requires Flash 6; file size is 15k. | View |

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| Electricity and Magnetism | Comparing a DC circuit to the flow of water. | A simple DC circuit has a DC voltage source lighting a light bulb.Also shown is a hydraulic system in which water drives a turbine. The two systems are shown to be similar. Requires Flash 6; file size is 51k. | View |
| Electricity and Magnetism | A Light Switch | A simple animation of how a common light Switch works. Requires Flash 6; file size is 4kb. | View |
| Electricity and Magnetism | Field Lines | Illustrating representing an electric field with field lines. Requires Flash 5; file size is 22k. | View |
| Electricity and Magnetism | A Simple Buzzer | A simple buzzer consisting of a battery, a flexibile metal strip, a piece of iron, and some wire. Requires Flash 6; file size is 20k. | View |
| Electricity and Magnetism | Electric Field of an Oscillating Charge | An electric charge is executing simple harmonic motion, and the animation shows the electric field lines around it. Requires Flash 6 and a computer with reasonable power; file size is 40k. | View |
| Electricity and Magnetism | Electric and Magnetic Fields of an Oscillating Charge | A 3 dimensional animation of the "far" fields of an oscillating charge. Requires Flash 6; file size is 120k. | View |
| Electricity and Magnetism | Circular Polarization | Circular polarization generated from a linearly polarized electromagnetic wave by a quarter-wave plate. Requires Flash 6; file size is **785k.** | View |
| Electricity and Magnetism | Spinning Charges and an Inhomogeneous Magnetic Field 1 | A spinning charged object passes through an inhomogeneous magnetic field. This animation is also used in a discussion of the Stern-Gerlach experiment. Requires Flash 6; file size is 74k. | View |
| Electricity and Magnetism | Spinning Charges and an Inhomogeneous Magnetic Field 2 | A spinning charged object passes through an array of 3 magnets each producing an inhomogeneous magnetic field. This animation is also used in a discussion of the Stern-Gerlach experiment. Requires Flash 6; file size is 79k. | View |
| Fluid Mechanics | Viscous Motion | Dropping a ball in a viscous liquid. The densities, liquid viscosity, and size of the ball are controllable. Requies Flash 6; file size is 55k. | View |
| Fluid Mechanics | Dropping a Ball From the CN Tower | A ball is dropped through the air from 350 m above the ground. The ball may be a billiard ball, a 5-pin bowling ball or a 10-pin bowling ball. The 5-pin bowling ball clearly shows the *drag crisis*. Requires Flash 7; file size is 133k. | View |
| Micrometer Caliper | Measuring with a Micrometer | A simple animation of using a micrometer to measure the width of a pencil. Requires Flash 5; file size is 13k. | View |
| Micrometer Caliper | An Exercise in Reading a Micrometer | Provides controls to position the micrometer, and when a button is clicked displays the reading. Requires Flash 5; file size is 30k | View |
| Miscellaneous | A Simple Piston and Boyle's Law | A small animation showing a piston compressing a sample of gas. As the volume of the gas goes down, the density and therefore the pressure goes up. Requires Flash 5; file size is 3.9k. | View |

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| Miscellaneous | Derivative of the Sine Function | An animation illustrating that the derivative of a sine function is a cosine. Requires Flash 6, file size is 20k. | View |
| Miscellaneous | Area of a Circle As a Limit | Illustrating that the area of a circle is a limit of the sum of the areas of interior triangles as the number of triangles goes to infinity. Requires Flash 5; file size is 12k. | View |
| Miscellaneous | Integration | Illustrating the meaning of the integral sign, including an example. Requires Flash 5; file size is 124k. | View |
| Nuclear | Scattering | Simulating nuclear scattering experiments by scattering ball bearings off targets. This is based on an experiment in the First Year Physics Laboratory at the University of Toronto. Requires Flash 6 Release 79; file size is 182k. | View |
| Nuclear | Nuclear Decays | The decay of 500 atoms of the fictional element Balonium. Uses a proper Monte Carlo engine to simulate real decays. Requires Flash 6, file size is 27k. | View |
| Nuclear | Pair Production | A simple illustration of electron-positron production and annihilation. Requires Flash 5, file size is 21k. | View |
| Nuclear | The Interaction of X-rays With Matter | Illustrating the 3 principle modes by which X-rays interact with matter. Requires Flash 6; file size is 47k. | View |
| Optics | Rotating a Mirror and the Reflected Ray | Illustrating that when a mirror is rotated by an angle, the reflected ray is rotated by twice that angle. Requires Flash 6; file size is 20k. | View |
| Optics | Reflection and Refraction | Illustrating reflection and refraction, including total internal reflection. Requires Flash 6; file size is 33k. | View |
| Optics | Object-Image Relationships | Ray tracing for a thin lens showing the formation of a real image of an object. Requires Flash 5; file size is 17k. | View |
| Optics | Using an Optical Bench | A simulation of an optical bench with a light source, object, thin lens and an image. The screen that displays the image is moved. Requires Flash 5, file size is 14k. | View |
| Oscilloscope | The Time Base Control 1 | Shows the effect of changing the time base control on the display of an oscilloscope. There is no input voltage. Requires Flash 5; file size is 10k. | View |
| Oscilloscope | The Time Base Control 2 | Shows the effect of changing the time base control on the display when there is an input voltage varying in time. Requires Flash 5; file size is 12k. | View |

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| Oscilloscope | The Time Base Control 3 | Shows the effect of changing the time base control on the display when there is an input voltage varying in time when the frequency of the voltage is high. Requires Flash 5; file size is 17k. | View |
| Oscilloscope | The Voltage Control | Shows the effect of changing the voltage control on the display. Requires Flash 5; file size is 10k. | View |
| Oscilloscope | The Trigger | Shows the effect of changing the trigger level on the display. Requires Flash 5; file size is 5.9k | View |
| Quantum Mechanics | The Bohr Model | The photon excitation and photon emission of the electron in a Hydrogen atom as described by the Bohr model. Requires Flash 6: file size is 77k. | View |
| Quantum Mechanics | Circular Standing Waves | Illustrating how thinking about the electron as a de Broglie wave "explains" the Bohr model. | View |
| Quantum Mechanics | Complementarity | Here we visualize a hydrogen atom, which consists of an electron in orbit around a proton. In one view the electron is a *particle* and in the other view it is a *probability distribution*. The reality is neither view by itself, but a composite of the two. Requires Flash 5; file size is 15k. | View |
| Quantum Mechanics | The Double Slit Experiment 1 | The famous "Feynman Double Slit Experiment" for electrons. Here we fire one electron at a time from the electron gun, and observe the build-up of electron positions on the screen. Requires Flash 5; file size is 15k. | View |
| Quantum Mechanics | The Double Slit Experiment 2 | Here we illustrate *Complementarity* using the double slit experiment. We view the path of the electron from the gun to the observing screen as a particle and as a wave. Requires Flash 5; file size is 33k. | View |
| Quantum Mechanics | Stern-Gelach Filters | Up to three Stern-Gerlach filters with user-controlled orientations are placed in an electron beam. Requires Flash 7; file size is 130k. | View |
| Quantum Mechanics | Bell's Theorem | Based on an analysis by Mermin, this animation explores correlation measurements of entangled pairs. Requires Flash 6; file size is 38k. | View |
| Relativity | Michelson-Morley Experiment | A simple analogy involving two swimmers that sets up the Michelson-Morley Experiment. Requires Flash 6; file size is 15k. | View |
| Relativity | Time Dilation | A demonstration that the phenomenon of time dilation from the special theory of relativity necessarily follows from the idea that the speed of light is the same value for all observers. Requires Flash 6; file size is 55k. | View |
| Relativity | Deriving Length Contraction | A tutorial that shows how relativistic length contraction must follow from the existence of time dilation. Requires Flash 5; file size is 37k. | View |

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| Relativity | Length Contraction is Invisible | This series of animations demonstrates that the relativistic length contraction is invisible. Requires Flash 5; file size is 90k. | View |
| Relativity | Deriving the Relativity of Simultaneity | A tutorial that shows how the relative nature of the simultaneity of two events must follow from the existence of length contraction. Requires Flash 5; file size is 39k. | View |
| Relativity | Twin Paradox | There are many ways of approaching this classic "paradox". Here we discuss it as an example of the relativistic Doppler effect. Requires Flash 6; file size is 116k. | View |
| Relativity | Foucault Pendulum and Mach's Principle | This began as an animation of the Foucault Pendulum, but then I generalized it to illustrate Mach's Principle. See also the simple Foucault Pendulum in the Classical Mechanics section. Requires Flash 6, file size is **1.5M**. | View |
| Relativity | Advance of the Perihelion | A simple animation showing Newton's and Einstein's predictions for the orbit of Mercury. Requires Flash 6; file size is 7.0k. | View |
| Sound Waves | Beats | Illustrating beats between 2 oscillators of nearly identical frequencies. Requires Flash 6; file size is 215k. | View |
| Sound Waves | Doppler Effect: Wave Fronts | Illustrating the wave fronts of a wave for a moving source. There are a few similar animations on the web: this is my re-invention of that wheel. Requires Flash 6; file size is 11k | View |
| Sound Waves | Doppler Effect | Illustrating the classical Doppler Effect for sound waves. Requires Flash 6; file size is 43k. | View |
| Sound Waves | Tuning Fork | A small animation of a vibrating tuning fork producing a sound wave. Requires Flash 5; file size is 2.7k. | View |
| Sound Waves | Pressure and Displacement Waves | This animation shows air molecules vibrating, with each molecule "driving" its neighbor to the right. It is used to illustrate that when the displacement wave is at a maximum then the density of the molecules, and thus the pressure wave, is at a minimum and vice versa. Requires Flash 5; file size is 30k | View |
| Sound Waves | Temperament | A very brief introduction to the physics and psychophysics of music, with an emphasis on temperament, the relationship between notes. Requires Flash 6 and sound; file size is 151k. | View |
| Vectors | Adding 2 Vectors | A simple demonstration of adding 2 vectors graphically. Also demonstrates that vector addition is commutative. Requires Flash 5; file size is 7k. | View |
| Vectors | Adding 3 Vectors | A simple demonstration of adding 3 vectors graphically. Also demonstrates that vector addition is associative. Requires Flash 5; file size is 10k. | View |

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| Vectors | Subtracting 2 Vectors | A simple demonstration that subtracting 2 vectors graphically is the same as adding the first one to the negative of the second one. Requires Flash 5; file size is 4.5k. | View |
| Vectors | Component Addition | A simple demonstration that to add 2 vectors numerically, just add the Cartesian components. Requires Flash 5; file size is 16k. | View |
| Vectors | Unit Vectors | A simple animation of unit vectors and vector addition. Requires Flash 6; file size is 12k. | View |
| Vectors | Dot Product | A simple demonstration of the relation between the dot product of 2 vectors and the angle between them. Requires Flash 6; file size is 8k. | View |
| Vectors | Right-Hand Screw Rule | The direction of the angular velocity vector given by a right-hand screw rule. Requires Flash 6; file size is 196k. Also linked to from the *Classical Mechanics* section. | View |
| Vectors | Cross Product | The direction of the cross product of 2 vectors is demonstrated. The magnitude shown is correct but not discussed. Requires Flash 6; file size is 44k. | View |
| Waves | Traveling Waves | Illustrating the sign of the time term for traveling waves moving from left to right or right to left. Requires Flash 6; file size is 42k. | View |
| Waves | A Plane Wave Traveling Through Two Mediums | Illustrating the relation between wavelengths and frequencies of a wave when it travels from one medium to another. Requires Flash 6; file size is 5.4k. | View |
| Waves | Refraction | The previous animation shows wave fronts entering the mediums with a zero angle of incidence. Here the angle of incidence is not zero. Requires Flash 6; file size is 11kb | View |
| Waves | Reflections From a Barrier | A wave is reflected from a barrier with a phase reversal. This is the behavior for transverse waves and the *displacement* aspect of a longitudinal wave. Requires Flash 5; file size is 42k. | View |
| Waves | Reflections From Two Barriers | A wave is reflected back and forth between two barriers, setting up a standing wave. Requires Flash 5; file size is 41k. | View |
| Waves | Standing Waves With a Node on Both Ends | The first three standing waves for nodes at both ends. The frequencies of the waves are proportional to one over the wavelength. Requires Flash 5; file size is 11k. | View |
| Waves | Standing Waves With a Node on One End | The first three standing waves for a node at one end and an anti node at the other. The frequencies are proportional to one over the wavelength. Requires Flash 5; file size is 18k. | View |

## Other Languages and Links

These animations have been translated into Catalan, Spanish and Basque:

En aquest enllaç http://www.meet-physics.net/David-Harrison podeu trobar la versió al català de les animacions Flash de Física.

Las animaciones Flash de Física se han traducido al español, y están disponibles en esta dirección: http://www.meet-physics.net/David-Harrison

Fisikako Flash animazioak euskeratu dira eta helbide honetan eskura daitezke http://www.meet-physics.net/David-Harrison

Many animations have been translated into Greek by Vangelis Koltsakis. The web site is: users.sch.gr/ekoltsakis/nt/harrison/harrison.htm

Many animations have been translated into Dutch by Jacques Bijvoet, Dalton Lyceum Barendrecht. http://www.xs4all.nl/~jafrma/Harrison/

Most animations have been translated into Hungarian by Sandor Nagy, Eötvös Loránd University. Üdv a magyar látogatónak! Nagy Sándor egyik gyűjteményében (http://nasa.web.elte.hu/Harrisonia/) 68 magyarított animációmat találja meg magyar szövegkörnyezetben.

Many animations have been translated into Polish by the edukator.pl team. Do wspaniałego dorobku Davida Harrisona polską wersję językową wykonał zespół edukator.pl - Fundacja Nauka i Wiedza. http://www.edukator.pl/APLETY,7365.html

*Tags recommended by the template:* article:topic