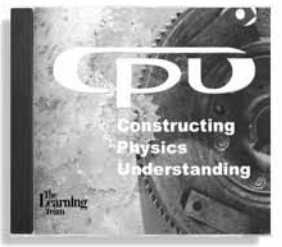
Enhancing the *Active Physics* Communication Unit with CPU Simulators



Constructing Physics Understanding (*CPU*) simulators are a rich resource, which allow teachers and students to explore fundamental physics concepts quickly and safely. Because images used in the *CPU* simulators look like the objects students use in the *Active Physics* units, the transition from hands-on activities to the simulations and back is fairly smooth. *CPU* simulations can be used to introduce topics, deepen understanding of topics covered, or extend studies to related areas. The usage notes correlating *CPU* simulator activities to the *Active Physics* unit should be considered carefully before classroom use to assist in planning computer access time and to provide a proper transition between the two.

CPU simulation activities have been written to: introduce sections where student prior experience may not allow them to make predictions called for in the *Active Physics* unit; supplement sections where visual reinforcement of concepts will enhance their level of understanding; and provide applications for concepts the unit has developed.

Materials in the *CPU* simulators have been designed to represent real objects. Bulbs and fuses can be burned out, batteries run down and shadows of extended objects have both penumbra and umbra. Once students are familiar with the *CPU* simulators, they can use them to investigate their own "what if" questions, allowing them to safely, quickly and cheaply extend the investigations initiated in *Active Physics*.

The Designed Simulations are setups for the *CPU* simulations that have been created to match the *Active Physics* units. Teachers who wish to design their own simulations or have capable students do so can use the *CPU* simulations palette to build custom simulations. Instructions on building and saving your own custom simulations can be found on the *CPU* simulation disk in the Tutorials folder. This is a comprehensive tutorial that allows the learner to read the instructions and perform the suggested actions on the same screen.

What follows is a cross-index between *CPU* simulator activities and the *Active Physics Communications* unit that attempts to use the strength of each. For example, after *Active Physics* has students construct a circuit to produce sound, the *CPU* simulations activity guides them to consider the role of the major components and the measurements that can be made in simple DC circuits. *CPU* activities and *Active Physics* share the background that both were developed in response to National Standards in science education and knowledge about student learning gained by the physics education research community.

Chapter 4: Let Us Entertain You

Active Physics Contents	Page Number	Matching CPU Simulators	Usage Notes
The designed simulations are setups that have already been created using the CPU Simulators. The CPU Simulators mentioned are blank palettes that teachers and students can use to design their own simulation investigations.			
Activity 1 Making Waves			
Physics Talk: Calculating the Speed of Waves	190	Designed simulation Wave Speed CPU Simulator: Ripple Lab	The designed simulation allows students to measure distance and time for a wave pulse in order to determine speed and also measure wavelength and frequency. This can be used by students to confirm equations stated on pages 190–191 or in lieu of Physics Talk to develop these equations.
Activity 2 Sounds in Strings			
Stretching Exercises	199	Designed simulation: Tuning Fork CPU Simulator: Sound Lab	The designed simulation can be used to add a third activity to the Stretching Exercises. Students will be asked to investigate tuning forks to extend the ideas they learned about strings.
Activity 3 Sounds from Vibrating Air			
For You To Read: Wave Diffraction	204	Designed simulation: Diffraction CPU Simulator: Ripple Lab	The designed simulation can be used to illustrate the material in the For You To Read section. Students will investigate the diffraction of water waves and explore the parameters that affect the amount of diffraction.
Activity 4 Making Sound Electronically			
Physics To Go	214		The four simulators that follow should be used after Physics To Go on page 215.
		Designed Simulation: DC Circuits1	The DC Circuits1 simulator establishes the relationship between current, resistance and voltage.
		Designed Simulation: DC Circuits2	In DC Circuits2, students discover the voltage rules for batteries in series and in parallel.
		Designed Simulation: DC Circuits3	DC Circuits3 develops the rules for resistors in series and in parallel.
		Designed Simulation: DC Circuits4 CPU Simulator: Current Electricity	DC Circuits4 reinforces the rule about resistance, current, and voltage and establishes the role of capacitors in a circuit.
Activity 5 Reflected Light			
Stretching Exercises	222	Designed Simulation: Periscope	The designed simulation can be used as an additional Stretching Exercise. Students will use the knowledge they gained in this activity to construct a periscope.
		CPU Simulator: Reflection & Refraction	The CPU simulator can be used to replace some of the activities in the For You To Do activities starting on page 217.

Chapter 4: Let Us Entertain You

Active Physics Contents	Page Number	Matching CPU Simulators	Usage Notes
Activity 6 Curved Mirrors			
Physics Talk	227	Designed Simulation: Curved Mirrors CPU Simulator: Mirror Images	The designed simulation should be run to confirm or develop the ideas in Physics Talk. In the Curved Mirror simulation, convex and concave mirror images are explored and the image size and location is investigated.
Activity 7 Refraction of Light			
For You To Do	231	Designed Simulation: Index of Refraction Total Reflection CPU Simulator: Reflection & Refraction	The Index of Refraction Simulation has students investigate what effect different materials have on the index of refraction. It best fits after Step 6 on page 232. The Total Reflection Simulation has students investigating total internal reflection in various materials. It best fits after Step 9 on page 232.
Activity 8 Effect of Lenses on Light			
For You To Do	237	Designed Simulation: Convex Lens CPU Simulator: Lens Images	The Convex Lens simulation can be used after Step 6 in the For You To Do activity to reinforce ideas developed thus far in this activity.
For You To Do	237	Designed Simulation: Focal Length CPU Simulator: Lens Images	The Focal Length simulation is a convenient way for students to test Step 9c in the For You To Do activity. The effect of different focal length lenses on the image size and location is demonstrated.
Stretching Exercises	242	Designed Simulation: Concave Lens CPU Simultor: Lens Images	The Concave Lens simulation can be used as an additional Stretching Exercise for students to see how concave lenses are different from convex lenses.
Activity 9 Color			
What Do You Think?	243	Designed Simulation: Colored Lights CPU Simulator: Color Beams	The Colored Lights simulator should be run before the For You To Do activity so students have an understanding about the mixing of colored lights before beginning this activity.
Reflecting on the Activity and the Challenge	246	Designed Simulation: Colored Shadows CPU Simulator: Shadows & Pinholes	This simulation can be used after the For You To Do exercise to reinforce the ideas developed in this activity.