

# Welcome to Interactive Physics

Interactive Physics is the result of a 15-year collaborative effort between physics instructors and software engineers. It is correlated with National Education Curriculum Standards and it teaches your students the same motion tools used by professional scientists and engineers. We are confident that Interactive Physics is a valuable tool for your classroom and laboratory.

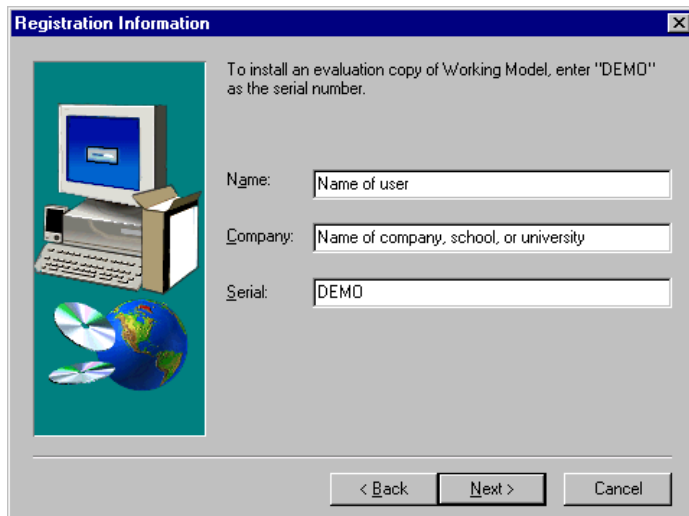
To begin, install Interactive Physics and go through each step of the demonstration described below.

| Step                                    | Related Physics Concepts   |
|---|--|
| 1. Creating a falling block             | Mass; freely falling objects; laws of motion; linear kinematics  |
| 2. Adding a velocity vector             | Vector and scalar quantities; vector components; unit vector   |
| 3. Making a pendulum                    | Oscillatory motion; frequency and amplitude; rotational kinematics; centripetal force  |
| 4. Graphing the pendulum's motion       | Graphs and measurements; motion diagrams   |
| 5. Changing gravity                     | Law of gravity; Newton's second law  |
| 6. Adding air resistance                | Air resistance; non-conservative forces  |
| 7. Adding a spring                      | Spring oscillation; conservative forces; conservation of energy; kinetic and potential energy  |
| 8. Controlling the spring constant      | Spring constant; natural spring length; equilibrium spring length  |
| 9. Collisions with a circle             | Collision; elasticity; frictional forces; impulse and momentum   |
| 10. Attaching a picture to an object    | Attaching pictures makes physics experiments realistic and fun   |
| 11. Adding sound                        | Sound waves; speed of sound; Doppler effect; sound frequency and intensity   |
| 12. Adding a curved slot joint          | Roller coaster physics; motion in two dimensions; conservation of energy and momentum  |
| 13. Adding a force                      | Concept of force; Newton's first law; work and energy  |
| 14. Running demo files                  | Interactive Physics allows you to explore other essential physics topics, including: electrostatics, evaporation and condensation, gears, kinetic theory of gas, machines, magnetism, particle dynamics, projectiles and rockets, pulleys, rotational dynamics, static equilibrium, superposition of waves, and many more. |
| 15. <a href="#">Curriculum workbook</a> | Correlated with National and State Standards and Objectives, new interactive experiments explore speed, distance, time, acceleration, force, weight, mass, gravity, and air resistance   |

## Installing Interactive Physics

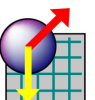
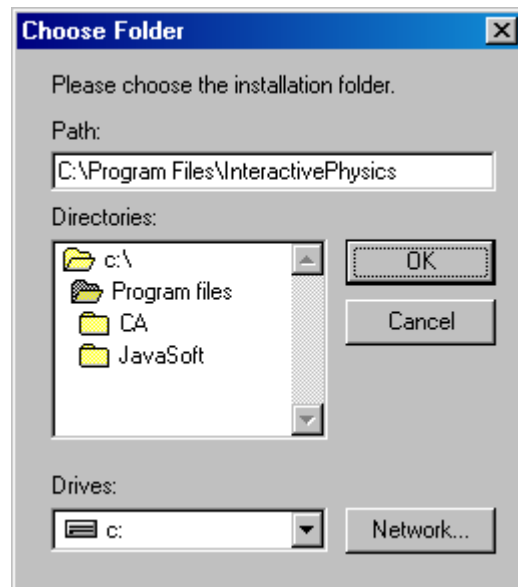
### Windows users:

1. Insert the Interactive Physics CD into the CD-Rom drive and follow the installation instructions
2. When prompted for a serial number, enter "DEMO" or enter your licensed serial number
3. When the "Choose Folder" window appears, click [OK].
4. For a step-by-step introductory tutorial, turn to the next page.



### Mac users:

1. Insert the Interactive Physics CD into the CD-Rom drive. Double-click on the InteractivePhysics CD-icon
2. Double-click on the DoubleClickToInstall icon in the interactivePhysics window. Follow the installation instructions
3. For a step-by-step introductory tutorial, turn to the next page.

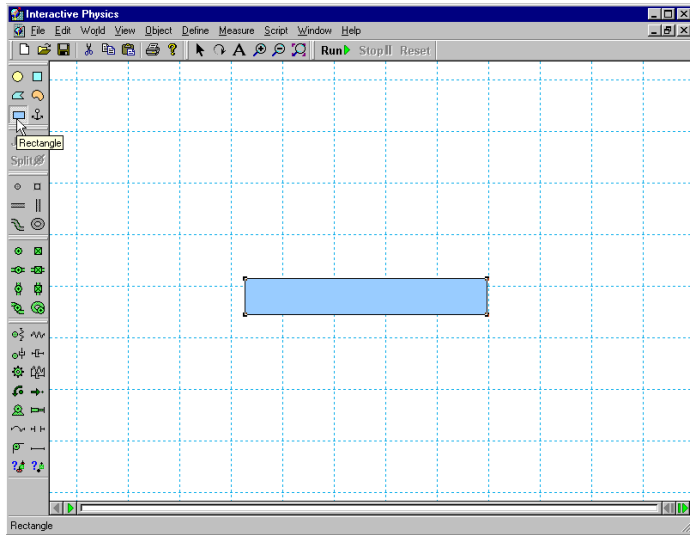


## Starting Interactive Physics

1. Ensure that Interactive Physics is installed on your computer.
2. From the Windows **Start** menu, click on Programs and then InteractivePhysics and then InteractivePhysics. This opens a new experiment.

## 1 Creating a Falling Block

1. The first simulation is Newton's first experiment, dropping a block.
2. To draw a rectangle, click on the Rectangle tool, then click in the workspace and draw a long thin rectangular block.
3. To run the experiment and see the block fall due to gravity, click **Run ▶**.
4. Click **Reset** to reset the experiment.



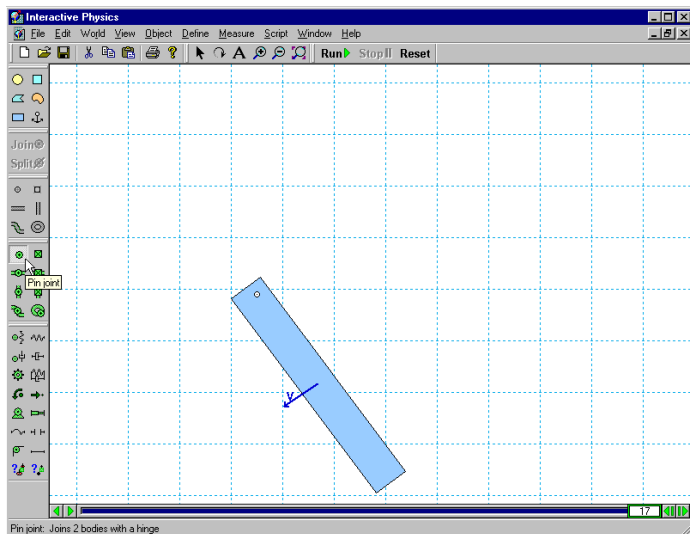
## 2 Adding a Velocity Vector

1. To add a velocity vector, click on the rectangle.
2. From the Define menu, click on Vectors and then Velocity.
3. Click **Run ▶** and observe that the vector changes magnitude as the block falls.
4. Click **Reset**.

Optional: To add a numerical value to the velocity vector (or its components), click on the Define menu, select Vector Display, and check the Value box.

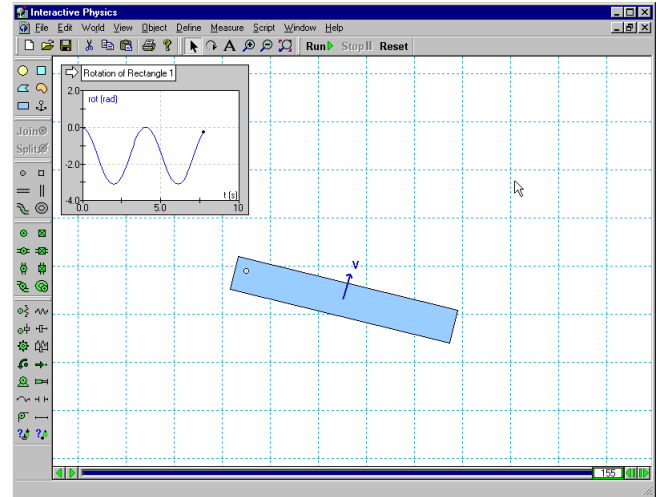
## 3 Making a Pendulum

1. To make a pendulum, click on the Pin joint tool and then click on the upper left-hand corner of the rectangle.
2. Click **Run ▶** and observe that the vector changes magnitude and direction as the pendulum moves. Click **Reset**.



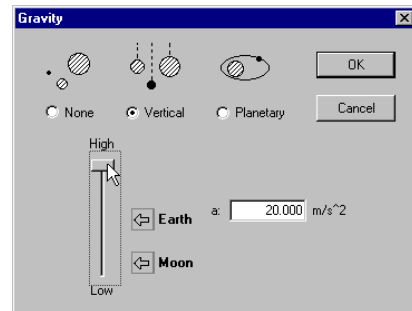
## 4 Graphing the Pendulum's Motion

1. To graph the pendulum's motion, click on the rectangle. Under the Measure menu, select Position, then select Rotation Graph.
2. To collect data, click **Run ▶**. Note: Data can be displayed as a graph, bar chart, or number, and can be changed while running the experiment. Click **Reset**.
3. The graph shows the pendulum's amplitude and frequency. To make the graph larger, click on the graph and drag its lower right-hand corner to the right.



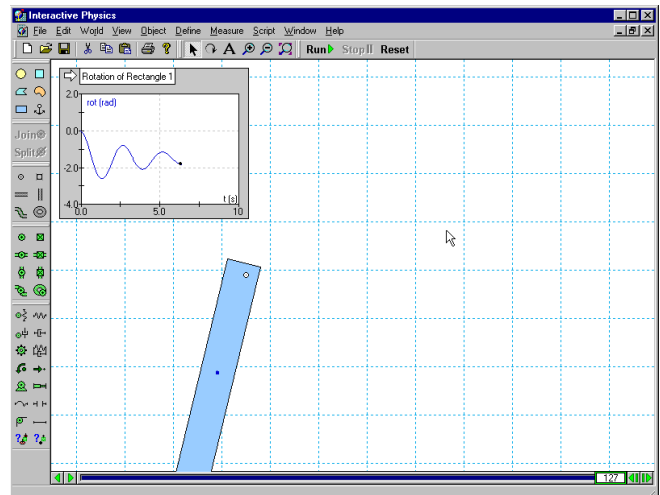
## 5 Changing Gravity

1. To change gravity, click on the World menu, select Gravity, slide the slider to the top for the value 20 m/sec<sup>2</sup>, and click [OK].
2. Click **Run ▶** and observe that, in agreement with theoretical and experimental predictions, the pendulum has a higher natural frequency. Click **Reset**.



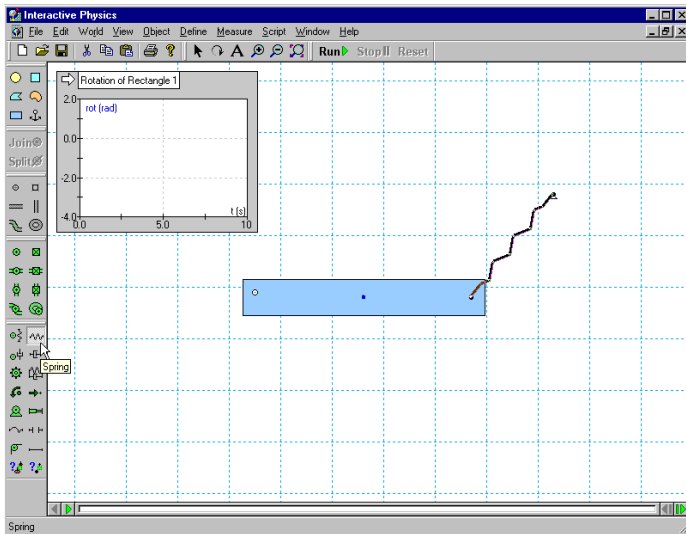
## 6 Adding Air Resistance

1. Under the World menu, select Air Resistance, click on Low Speed, and accept the default air resistance value of 0.3 kg/(m\*s) by clicking [OK].
2. Click **Run ▶** and observe the exponentially decaying oscillations. Click **Reset**.



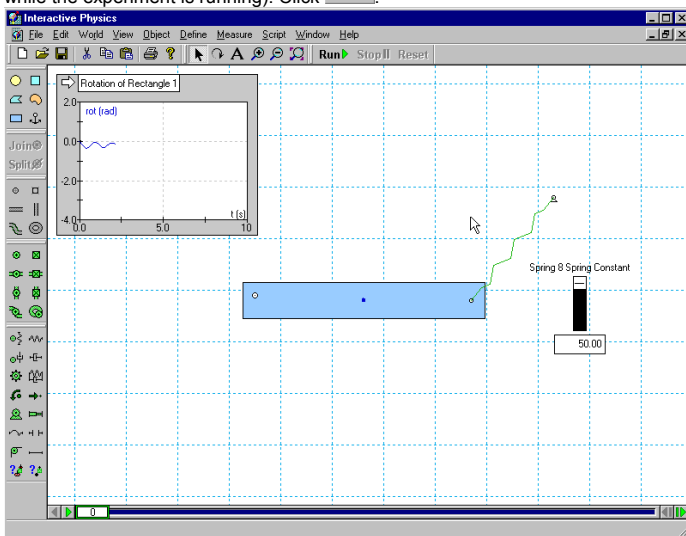
## 7 Adding a Spring

1. To add a spring, click on the Spring tool. Click on the upper right-hand corner of the block and stretch the spring up and to the right.
2. Click **Run ▶** and observe the pendulum's higher natural frequency and new equilibrium position. Click **Reset**.



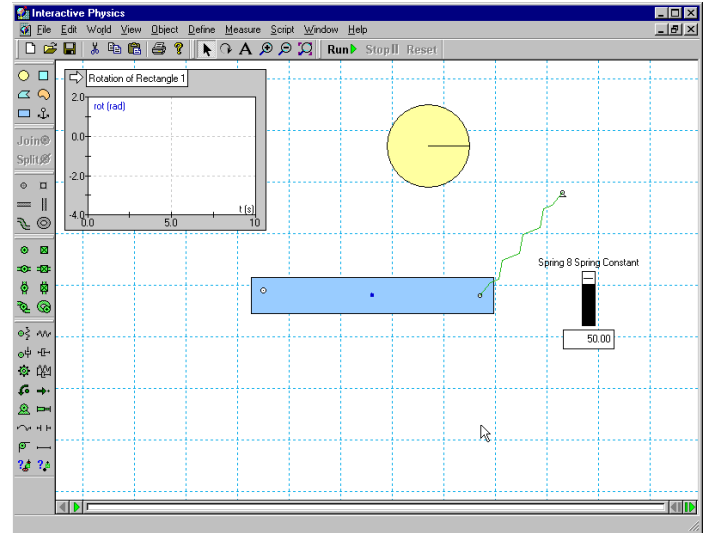
## 8 Controlling the Spring Constant

1. To control the spring constant, click on the spring. Under the Define menu, select New Control, then select Spring Constant.
2. The slider that controls the spring will appear in the left-hand side of the workspace. To move the slider's location closer to the spring, click on its **title** and drag it next to the spring.
3. To see the effect of varying the spring constant, click **Run ▶** and observe that the pendulum angle is a function of the spring-constant (move the slider up and down while the experiment is running). Click **Reset**.



## 9 Collisions with a Circle

1. To create a circle, click on the Circle tool, then click in the workspace and draw a circle. (If your rectangle is high on the screen, click to zoom to extents.)
2. Click **Run ▶** to start the experiment and observe that the circle bounces and rolls on top of the rectangle. Automatic collision and contact is a very useful feature in Interactive Physics (even the elastic and frictional properties of objects may be varied). Click **Reset**.



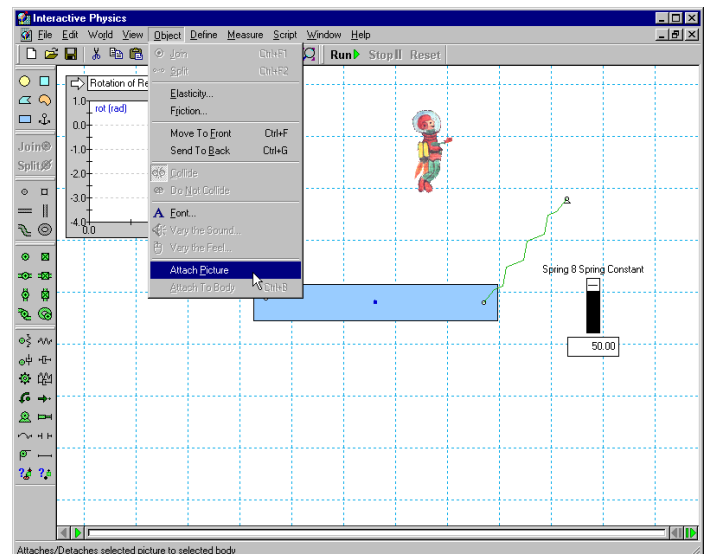
## 10 Attaching a Picture to an Object

1. To find the spaceman picture on Windows, select menu, then Programs, then InteractivePhysics, then the IPIntroduction folder.

*Note: Mac users browse to Interactive Physics, then Picture Library, then People.*

2. Double-click on the bitmap file "Spaceman.bmp." This should open the bitmap in a program such as Paint.
3. In Paint, select the Edit menu and then choose Select All. Next, select the Edit menu again and then choose Copy.
4. Go back to Interactive Physics and select its Edit menu and then choose Paste.
5. To attach the spaceman bitmap to the circle, click on the spaceman, then hold down [Shift] while you click on the circle.
6. Select the Object menu and then Attach Picture. Notice that the circle object has disappeared and has been replaced by the spaceman image.
7. Click **Run ▶** to run the experiment. Click **Reset**.

*Note: Interactive Physics was designed to be easy-to-use. In this exercise, the only time you need to touch the keyboard is to hold down the [Shift] key.*

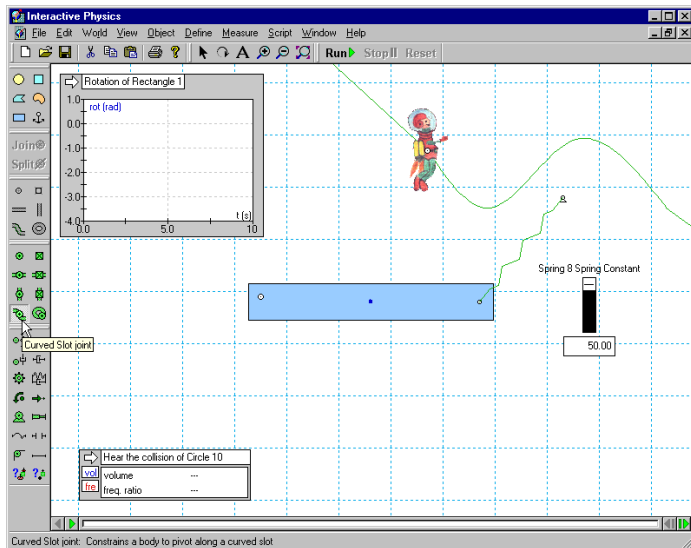


## 11 Adding Sound (Windows only)

1. Click on the spaceman, select the Measure menu and choose Hear the Collision.
2. Click **Run** to start the experiment and hear the sound when the spaceman contacts the block. Click **Reset**.

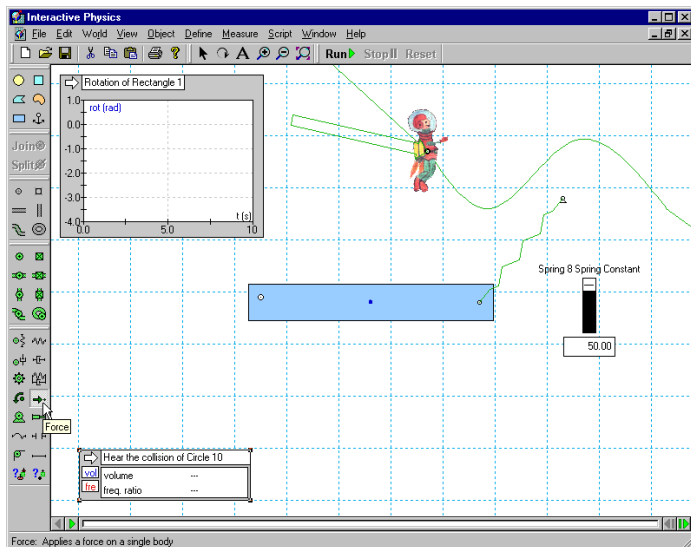
## 12 Adding a Curved Slot Joint

1. To add a Curved Slot Joint, click on the Curved Slot joint tool.
2. Click on the spaceman and then click on a couple of other places to the right of the spaceman, and then double-click to complete the slot (see figure below).
3. Click **Run** to start the experiment and observe that the spaceman slides down the curved slot. Click **Reset**.



## 13 Adding a Force

1. To add thrust to the spaceman to overcome air resistance, click on the Force tool, then click on the spaceman, then move the mouse to the left and click again.
2. Click **Run** to start the experiment and observe that the spaceman overcomes air resistance and moves more quickly along the curved slot. Click **Reset**.



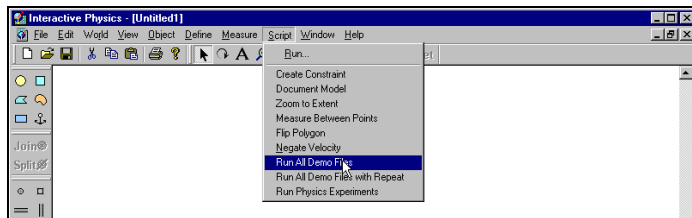
## 14 Running Demo Files

### Windows users:

1. Under the Script menu, click on "Run All Demo Files."
2. Sit back and enjoy a series of demos on a variety of physics topics.
3. To quit, select the File menu and choose Exit.

### Mac Users:

1. Browse to the For Demo Users folder installed with Interactive Physics.
2. Double-click on each of the files, then click Run.
3. To quit, select the File menu and choose Quit.



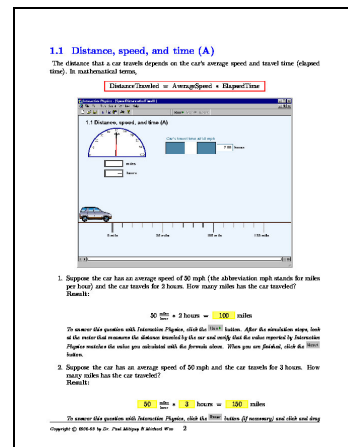
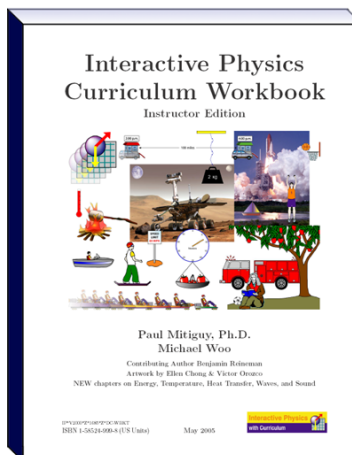
## 15 Curriculum Workbook

Supplementary workbooks with Interactive Physics exercises of varying difficulty are available with purchase. To try the instructional curriculum:

**Windows users:** Go to the Windows **Start**, then Programs, then InteractivePhysics, then click on StartCurriculum.html, then choose **Demo Users**.

**Mac users:** Open the installation CD and double-click on each of the files in the IPCurriculum folder. Follow the on-screen directions.

Note: The Demo Edition can open **only** Demo files. The Full Edition must be purchased to open the curriculum and additional 150+ physics experiments.



**New interactive experiments explore concepts in Energy, Temperature, Heat Transfer, Waves, and Sound**

**Plus experiments in speed, distance, time, acceleration, force, weight, mass, gravity, and air resistance**

**New curriculum workbook correlated with National and State Educational Standards and Objectives**

**Full-color teacher edition and black-line master student edition**

