Lab Materials Selection Worksheet
Conceptual Physics

These questions will help expedite the selection of items needed for your *Conceptual Physics* (CP) class. Complete the worksheet before beginning to select equipment at www.arborsci.com.

1. How many teachers will be teaching CP?	
2. How many students will be taking CP?	
3. How many separate sections are scheduled?	
4. How many student groups will be in the largest section? (Labs are most effective with groups of 3-4 students each.)	

The number of lab groups is the most important in choosing the correct amount of equipment. Recommended quantities of most lab materials should be based on students breaking out into lab group. Therefore, supply quantities should be based on the number of lab groups in your class with consumable supply quantities based on the number of times the lab would done for each period.

5. Do you have a computer available that the whole class can view?	
6. Do you have computers for each student group?	

A few of the labs in CP call for computer-based measurements. Many others can be greatly enhanced with the addition of computer data collection equipment (timers, photogates and motion sensors). We recommend one Timer and Photogate set per student group, but you can easily adjust this number to suit your capabilities. If you have only one classroom demonstration computer, choose a quantity of 1 for the Timer & Photogate and the Go! Motion Sensor. For more information on this equipment, click the More Info link in the product summary contained in each lab.

We realize that few teachers are able to cover every chapter or complete every lab, and few teachers need every piece of equipment listed in the entire lab manual. You will have the opportunity to choose equipment for one lab at a time, creating a master list. You can then eliminate duplicate items and adjust quantities to suit your class size and budget. Use the following outline as a guide and choose which chapters and labs will best meet your goals. Many teachers recommend one lab per week (usually 30-35 total). Check your own schedule and plan ahead before buying equipment.

To help you with your planning, we consulted Paul Robinson, author of the Conceptual Physics Laboratory Manual. The “Recommended” labs marked in the following chart are the labs that Robinson’s students normally complete in his physics class. They reflect his preferences and may or may not meet the needs of your individual school.

Check the box next to chapters and labs you will include in your curriculum.

> ***Note on Lab Numbering:*** *A.B, where A is the chapter number and B is the lab number. Lab number 0 is always a list of applicable teacher demos in that chapter. Lab numbers 01, 02, etc… are Arbor Scientific Enhancement Labs (see p. 6.) Other lab numbers (1-99) correspond to the numbers in the* Conceptual Physics Lab Manual*. Lab 100 includes items used many times throughout the year. They should be considered required materials for any CP curriculum.*

Conceptual Physics				
	Recommended	X		
	Enhancement Lab		X	
Ch.Lab	Your Choices			✓
100	Many Labs	X		
	The items in this list (basic supplies such as hooked masses, meter sticks, thermometers, etc…) occur in many labs throughout the CP lab manual. We recommend a classroom set of each of these items.			
1.0	Chapter 1: About Science	X		
1.1	Making Hypotheses	X		
2.0	Chapter 2: Linear Motion	X		
2.2	The Physics 500			
2.3	The Domino Effect	X		
2.4	Merrily We Roll Along!			
2.5	Conceptual Graphing	X		
2.6	Race Track			
3.0	Chapter 3: Projectile Motion	X		
3.7	Bull's Eye	X		
4.0	Chapter 4: Newton's First Law of Motion	X		
4.01	Vector Addition of Forces (text p. 53)		X	
4.8	Going Nuts	X		
4.9	Buckle Up!			
4.10	24-Hour Towing Service	X		
5.0	Chapter 5: Newton's Second Law of Motion	X		
5.11	Getting Pushy	X		
5.12	Constant Force and Changing Mass	X		
5.13	Constant Mass and Changing Force	X		
5.14	Impact Speed			
5.15	Riding with the Wind			
6.0	Chapter 6: Newton's Third Law of Motion	X		
6.01	Newton's 3rd Law: Balloon Helicopter		X	
6.02	Bottle Rockets		X	
6.16	Balloon Rockets			
6.17	Tension	X		
6.18	Tug-of-War			
7.0	Chapter 7: Momentum	X		
7.19	Go Cart	X		
7.20	Tailgated by a Dart			
8.0	Chapter 8: Energy	X		
8.01	Physics Workshop: Pulleys		X	
8.02	Physics Workshop: Lever		X	
8.21	Making the Grade	X		
8.22	Muscle Up!	X		
8.23	Cut Short	X		
8.24	Conserving Your Energy			

8.25	How Hot Are Your Hot Wheels?			
8.26	Wrap Your Energy in a Bow			
8.27	On a Roll			
8.28	Releasing Your Potential			
8.29	Slip-Stick			
9.0	Chapter 9: Circular Motion	X		
9.30	Going in Circles	X		
10.0	Chapter 10: Center of Gravity	X		
10.01	Center of Gravity: Balancing Bird		X	
10.31	Where's Your CG?	X		
11.0	Chapter 11: Rotational Mechanics	X		
11.32	Torque Feeler	X		
11.33	Weighing an Elephant	X		
11.34	Keeping in Balance	X		
11.35	Rotational Derby	X		
12.0	Chapter 12: Universal Gravitation			
13.0	Chapter 13: Gravitational Interactions	X		
13.36	Acceleration of Free Fall			
13.37	Computerized Gravity			
13.38	Apparent Weightlessness	X		
14.0	Chapter 14: Satellite Motion	X		
14.39	Getting Eccentric	X		
14.40	Trial and Error	X		
15.0	Chapter 15: Special Relativity—Space and Time			
16.0	Chapter 16: Special Relativity—Length, Momentum, and Energy			
17.0	Chapter 17: The Atomic Nature of Matter	X		
17.41	Flat as a Pancake	X		
17.42	Extra Small	X		
18.0	Chapter 18: Solids			
18.01	Measuring Density		X	
18.43	Stretch			
18.44	Geometric Physics			
19.0	Chapter 19: Liquids	X		
19.01	Cartesian Divers		X	
19.45	Eureka	X		
19.46	Sink or Swim	X		
20.0	Chapter 20: Gases			
20.01	Elasticity of Gases		X	
20.47	Weighty Stuff			
20.48	Inflation			
21.0	Chapter 21: Temperature, Heat, and Expansion	X		
21.49	Heat Mixes: Part I	X		
21.50	Heat Mixes: Part II	X		
21.51	Antifreeze in the Summer?			
21.52	Gulf Stream in a Flask			
21.53	The Bridge Connection	X		
22.0	Chapter 22: Heat Transfer			

22.01	Heat Conduction		X	
22.02	Heat and Radiation		X	
22.54	Cooling Off			
22.55	Solar Equality			
22.56	Solar Energy			
23.0	Chapter 23: Change of Phase	X		
23.57	Boiling Is a Cooling Process			
23.58	Melting Away			
23.59	Getting Steamed Up			
23.60	Changing Phase			
23.61	Work for Your Ice Cream	X		
23.62	The Drinking Bird	X		
24.0	Chapter 24: Thermodynamics			
24.63	The Uncommon Cold			
25.0	Chapter 25: Vibrations and Waves	X		
25.01	Wave Properties		X	
25.64	Tick-Tock	X		
25.65	Grandfather's Clock	X		
25.66	Catch a Wave	X		
25.67	Ripple While You Work			
26.0	Chapter 26: Sound	X		
26.68	Chalk Talk			
26.69	Mach One	X		
27.0	Chapter 27: Light	X		
27.70	Shady Business			
27.71	Absolutely Relative			
27.72	Shades	X		
28.0	Chapter 28: Color			
28.73	Flaming Out			
29.0	Chapter 29: Reflection and Refraction	X		
29.74	Satellite TV			
29.75	Images	X		
29.76	Pepper's Ghost	X		
29.77	The Kaleidoscope			
29.78	Funland			
30.0	Chapter 30: Lenses	X		
30.01	Light and Optics (can be used in chapters 28-30)		X	
30.79	Camera Obscura			
30.80	Thin Lens	X		
30.81	Lensless Lens	X		
30.82	Bifocals			
30.83	Where's the Point?			
30.84	Air Lens	X		
31.0	Chapter 31: Diffraction and Interference	X		
31.85	Rainbows Without Rain	X		
32.0	Chapter 32: Electrostatics			
32.86	Static Cling			
33.0	Chapter 33: Electric Fields and Potential			

34.0	Chapter 34: Electric Current	X		
34.87	Sparky, the Electrician	X		
34.88	Brown Out			
34.89	Ohm Sweet Ohm			
35.0	Chapter 35: Electric Circuits	X		
35.90	Getting Wired			
35.91	Cranking Up	X		
35.92	3-Way Switch	X		
36.0	Chapter 36: Magnetism			
36.93	3-D Magnetic Field			
36.94	You're Repulsive			
37.0	Chapter 37: Electromagnetic Induction			
37.95	Jump Rope Generator			
38.0	Chapter 38: The Atom and the Quantum	X		
38.96	Particular Waves	X		
39.0	Chapter 39: The Atomic Nucleus and Radioactivity	X		
39.97	Nuclear Marbles	X		
39.98	Half-Life			
40.0	Chapter 40: Nuclear Fission and Fusion			
40.99	Chain Reaction			

Enhancement Lab Options

Arbor Scientific provides specialized equipment that can substitute for some of the general materials listed in the CP Lab Manual. Each substitution is described below. Choose one or the other set of equipment, not both, for each lab listed. (Example: Timer and Photogates substituted for Stopwatches) For more information on any of these items click on the More Info link in the product summary provided with each lab.

Ch.Lab	Lab	Items	Can substitute for
	Many Labs	Timer & Photogates, Go! Motion Sensor, and other sensors	Apple computer and interface box, various probes and sensors
2.6	Race Track	Car & Ramp Workshop Stand	Pulley, Adjustable Dynamics Carts
5.12	Constant Force and Changing Mass	Car & Ramp Workshop Stand	Pulley, Adjustable Dynamics Carts
5.13	Constant Mass and Changing Force	Car & Ramp Workshop Stand	Pulley, Adjustable Dynamics Carts
8.21	Making the Grade	Car & Ramp Workshop Stand	Board Ring Stand Clamp Dynamics Carts
8.24	Conserving Your Energy	Pendulum Lab Workshop Stand	Ring Stand Pendulum Clamp Pendulum Bob String
25.64	Tick Tock	Pendulum Lab Workshop Stand	Ring Stand Pendulum Clamp Pendulum Bob String
25.65	Grandfather's Clock	Pendulum Lab Workshop Stand	Ring Stand Pendulum Clamp Pendulum Bob String
25.66	Catch A Wave	Crocodile Physics software	Good Stuff software
30.80	Thin Lens	Crocodile Physics software	Good Stuff software

Physics Workshop

The Physics Workshop is a collection of engaging, easy-to-use lab experiments crafted from sturdy materials. The five labs in the collection are designed to integrate together, providing a complete hands-on study of the basics of force, motion, and simple machines. Some of the labs are listed here as substitutes for other equipment, and some are recommended within the "Chapter Demos" listings, to enhance student learning.

Car & Ramp

Allows students to experiment with the relationships among position, time, velocity, and acceleration using datalogger technology. Later, they can use the apparatus for experiments in force and simple machines. A teacher's guide with student worksheets is included, for additional explorations into force and motion.

Pendulum

Demonstrates properties of a pendulum (frequency, period) and the transfer of energy from potential to kinetic. Using datalogger technology, students can perform quantitative analysis on the Pendulum and test the law of conservation of energy. Teacher's Guide included for additional lab ideas.

Lever

Show how simple machines can multiply force with the Lever. A teacher's guide with student worksheets is included, and the activities correlate with the content in section 8.7 of the CP text.

Pulleys

Another example of simple machines from section 8.7, the pulleys allow students to experiment with various combinations of fixed and movable pulleys. Teacher's Guide included.

Software Recommendations

Simulation software is an excellent way to supplement students' hands-on experiences in the lab. Two titles are recommended for use in Conceptual Physics classes.

Interactive Physics

The standard in simulation software, IP lets students set parameters and design most any mechanical simulation they can imagine.

Crocodile Physics

Specifically recommended as a substitute for the wave simulations from *Good Stuff*, Crocodile Physics also enables students to model electric circuits, mechanical situations, and color/light experiments.

Other Enhancements

Some of the "Chapter Demos" lists will include class sets of lab equipment that can help you introduce a lab where there wasn't one before. We've taken care to only recommend the best equipment that specifically addresses content from the Conceptual Physics textbook.

Light Box and Optical Set

Give students hands-on experience with ray optics (reflection, refraction) and color addition and subtraction with this well-known set. Use the ***Light and Color Teacher's Guide*** for complete lab writeups, including reproducible student worksheets.

Options for Common Items

Lab 100 (Many Labs) recommends 6 sets each of Spring Scales and Hooked Masses. Some labs call for individual scales or masses. To avoid unnecessary duplicates, the contents of these two sets are listed below:

Spring Scales Set (01-6970): 250g, 500g, 1kg, 2kg, 3kg, and 5kg, also marked in N.

Hooked Mass Set (P1-1000): 10g, two 20g, 50g, 100g, two 200g, 500g, and 1000g.

Some labs call for a hot plate or Bunsen burner. For convenience in many classroom types, the recommended materials include butane-fueled hot plates and burners. Electric hot plates and traditional Bunsen burners are listed as options, but you must input the required quantities by hand.

Complete descriptions of all of these items, or any other items from the "Chapter Demos" lists, can be found at www.arborsci.com or by calling 800-367-6695 for assistance.

Choosing Lab and Demo Materials

After you have completed your lab and demo choices, return to the lab materials selection page at www.arborsci.com. Using the Lab Menu on the Lab Manual home page follow these instructions to create your list.

Instructions:

Step 1. Download and print the Guiding_Worksheet and organize the labs and topics your classes will cover during the section.

Step 2. After reviewing and making decisions using the Guiding Worksheet, select each lab from the menu to make selections of needed equipment.

Step 3. Each Lab selection will open a new widow for that lab. After you have completed your choices for the lab, click Return to Lab Menu to continue to the next lab selection.

Step 4. After completing your equipment selections or at any point during the process you can click the "Shopping Cart" to see or edit equipment selections. You can navigate between the Shopping Cart and the Lab Menu at any time and modify quantities and remove duplications. You can also print a copy of the shopping cart for reference.

Step 5. Simplify organizing your lab supplies when they arrive! Here is a link to download a spreadsheet providing you with a complete list of lab numbers, titles and items associated with each lab. Download Spreadsheet

Items Not Supplied:

This list shows items that appear on materials lists for labs in CP, but are not supplied by Arbor Scientific. Most of the items are easily and inexpensively obtained at any grocery or discount store. Others may be brought from home by you or your students. Quantities are based on the needs of 100 students and 6 lab groups per class. For duplicated items, check individual labs to find the total amounts needed.

Lab #	Lab Name	Item	Quantity	Source
	Many Labs	Masking Tape		Store/School
		Computer		Classroom
		Graph Paper		Graph Paper Printer. Free download at http://www.marquis-soft.com/graphpapeng.htm
		Large Paper Clips		Store/School
		Water, hot and cold		Classroom
		Paper		Students/Classroom
		Paper Towels		Classroom
1.1	Making Hypotheses	500-mL beaker	1	Any container will work
2.4	Merrily We Roll Along!	Wood Block	6	Home/Hardware store
2.5	Conceptual Graphing	Marking Pen	6	Classroom
2.5	Conceptual Graphing	Soup can (Hewitt recommends Bean and Bacon) or large steel ball	6	Grocery store
2.5	Conceptual Graphing	Board	6	Hardware Store
2.6	Race Track	Colored Pencils	60	Store
3.7	Bull's Eye	Empty soup can	6	Home
3.7	Bull's Eye	Plumb line	6	Hang small mass on string
4.9	Buckle Up!	Small dolls	12	Home
4.9	Buckle Up!	Wood Blocks	12	Home
5.11	Getting Pushy	Roller skates or skateboard	6	Students
5.14	Impact Speed	Rock	6	Outside
5.14	Impact Speed	Leaf or feather	6	Outside
5.14	Impact Speed	Styrofoam plastic foam ball or Ping Pong ball	6	Store / Home
6.17	Tension	Marking pen	6	Classroom
7.19	Go Cart	Brick or heavy weight (or use recommended C-clamps)	12	Home
8.21	Making the Grade	Board for Inclined Plane	6	Hardware Store
8.22	Muscle Up!	Bleachers and/or stairs		Classroom
8.22	Muscle Up!	Weights		Home/Gym
8.27	On a Roll	Tennis ball	6	Home / Grocery
8.27	On a Roll	Carpet		School
8.29	Slip-Stick	Friction Block (Wood block with sandpaper on one surface)	6	Hardware store
8.29	Slip-Stick	Flat board	6	Home/Hardware store
8.29	Slip-Stick	Shoe	6	Home
10.31	Where's Your CG?	Reaction board, 8' x 2" x 12"	6	Hardware
10.31	Where's Your CG?	Bricks	12	Home
10.31	Where's Your CG?	2 large triangular supports (1" angle iron)	12	Hardware Store
11.34	Keeping in Balance	Rock or unknown mass	6	Outside
11.35	Rotational Derby	Smooth, flat board, 1m long	6	Home
11.35	Rotational Derby	Empty cans	18	Home / Students
11.35	Rotational Derby	Unopened cans, 3 different diameters, "solid" contents (like chili)	18	Grocery
11.35	Rotational Derby	Unopened soup cans, one liquid (chicken broth) and one "solid" per group (cream of mushroom)	12	Grocery

13.38	Apparent Weightlessness	Plastic or foam cups	12	Grocery
14.39	Getting Eccentric	Thumbtacks	12	Classroom
17.41	Flat as a Pancake	Tray (pizza pan)	6	Store
17.42	Extra Small	Tray (pizza pan)	6	Store
18.44	Geometric Physics	Salt	2 lb	Grocery
18.44	Geometric Physics	Rock salt	2 lb	Grocery
19.45	Eureka	Scrap iron	6	Auto shop
19.45	Eureka	Lead shot		Flinn L0090, 250g
19.45	Eureka	Bolts (or order additional PX-2124)		Hardware
19.46	Sink or Swim	Clear container	6	Hardware
19.46	Sink or Swim	Chunk of wood	6	Home
19.46	Sink or Swim	Toy boat	6	Grocery / Home
20.47	Weighty Stuff	Basketball	6	PE Teacher
20.47	Weighty Stuff	Needle valve	6	PE Teacher
20.48	Inflation	Automobile	1	Teacher / Student
20.48	Inflation	Owner's manual for vehicle	1	
21.49	Heat Mixes: Part 1	Styrofoam cups	100	Grocery
21.49	Heat Mixes: Part 1	Pails for water	2	Home/Hardware/Classroom
21.50	Heat Mixes: Part II	Styrofoam cups (large)	100	Grocery
21.51	Antifreeze in the Summer?	Antifreeze mixture	1 gallon	Hardware
21.52	Gulf Stream in a Flask	Food coloring	2 boxes	Grocery
22.54	Cooling Off	Variety of containers		Home
22.54	Cooling Off	Styrofoam cups with covers	6	Grocery/GFS
22.54	Cooling Off	Crushed ice w/water		School
22.54	Cooling Off	100W Light Bulb	6	Grocery
22.55	Solar Equality	Aluminum foil	1 roll	Grocery
22.55	Solar Equality	Wood blocks	12	Home/Hardware
22.55	Solar Equality	Glass jar with a hole in the metal lid	6	Grocery
22.55	Solar Equality	Glycerin		Flinn G0019, 100mL. (800-452-1261)
22.55	Solar Equality	100W Light Bulb	6	Grocery
22.56	Solar Energy	Styrofoam cups	12	Grocery
22.56	Solar Energy	Food coloring	1 box per group	Grocery
22.56	Solar Energy	Plastic wrap	1 roll	Grocery
23.57	Boiling Is a Cooling Process	Crushed ice		Lunchroom
23.57	Boiling Is a Cooling Process	pan or tub	6	Home
23.58	Melting Away	Styrofoam cups	6	Grocery
23.58	Melting Away	Ice cube	100	Lunchroom
23.59	Getting Steamed Up	Styrofoam cups, large	18	Grocery
23.60	Changing Phase	Paraffin Wax Flakes		Craft store (candles)
23.61	Work for Your Ice Cream	Homemade ice cream machine, Rock Salt type	1	Home / Store
23.61	Work for Your Ice Cream	Ice		Grocery
23.61	Work for Your Ice Cream	Rock salt		Grocery
23.61	Work for Your Ice Cream	Insulated cups	100	Grocery
23.61	Work for Your Ice Cream	Ice cream mix	1 per class	Grocery
24.63	The Uncommon Cold	Ice bucket or container	6	Grocery
24.63	The Uncommon Cold	Ice		Lunchroom
26.68	Chalk Talk	New piece of chalk	6	Classroom
26.68	Chalk Talk	Chalkboard	1	Classroom
26.69	Mach One	Rubber band	6	Classroom

26.69	Mach One	Alka-Seltzer	100	Grocery
27.70	Shady Business	Book or other opaque object	6	Classroom
27.70	Shady Business	Screen or wall	1	Classroom
27.70	Shady Business	200W Frosted Light Bulb	6	Grocery
27.72	Shades	100W Light Bulb	6	Grocery
28.73	Flaming Out	100W Light Bulb	6	Grocery
29.74	Satellite TV	Small transistor radio	6	Teacher / Student
29.74	Satellite TV	Large umbrella	6	Teacher
29.74	Satellite TV	Aluminum foil	1 roll	Grocery
29.75	Images	Transparent tape	6 rolls	Classroom
29.76	Pepper's Ghost	Matches or lighter	6	Teacher
29.77	The Kaleidoscope	Transparent tape	6 rolls	Classroom
29.77	The Kaleidoscope	Viewing object (any small object)	6	Students/Classroom
29.78	Funland	Cardboard (~12” square)	6	School
30.79	Camera Obscura	Shoe box	30	Teacher/Students
30.81	Lensless Lens	3" x 5" card	30	Grocery
30.81	Lensless Lens	Straight pin	30	Grocery
30.82	Bifocals	Cardboard (~12” square)	6	School
30.84	Air Lens	Screen	1	Classroom
31.85	Rainbows Without Rain	Soap-bubble solution	6 bottles	Grocery
31.85	Rainbows Without Rain	Oil (motor oil or other)		Hardware/Grocery
31.85	Rainbows Without Rain	Wire frame (any wire or coat hanger, bent)	6	Home
31.85	Rainbows Without Rain	Cookie sheet	6	Teacher
32.86	Static Cling	Foam rubber	6	Home
32.86	Static Cling	Syrofoam peanuts - packing material	6	Home/Students
32.86	Static Cling	Coin	6	Teacher / Students
32.86	Static Cling	Empty soup or soda can	6	Teacher / Students
34.88	Brown Out	CASTLE Kit	6	Pasco EM-8624A or EM-8654. (800-772-8700)
36.94	You’re Repulsive	Old Apple II or Cathode Ray Oscilloscope	1	
37.95	Jump Rope Generator	50' extension cord	6	Hardware
38.96	Particular Waves	Steel wool	6	Grocery
38.96	Particular Waves	200W Frosted Light Bulb	6	Grocery
39.98	Half-Life	Shoe box and lid	6	Teacher / Students
39.98	Half-Life	200 or more pennies	6	Teacher / Students
40.99	Chain Reaction	Large table or floor space		Classroom