

## Correlation to Illinois Learning Standards for Science

### *CPO Science Physics: A First Course, 2nd Edition*

#### Student Text and Investigation Manual

| Standard #:<br>Area           | State Goal  | Learning Standard  | Learning Expectation  | student text<br>pg          | detail   | investigation<br>pg                          | detail   |
|-------------------------------|---|--|---|-----------------------------|--|--|--|
| 11.A.4a<br>Scientific Inquiry | Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems. | Know and apply the concepts, principles and processes of scientific inquiry. | Formulate hypotheses referencing prior research and knowledge.    | 8<br>8<br>196<br>244<br>280 | formulating a hypothesis<br>hypothesis defined<br>the evidence supports the conclusion<br>draw a conclusion that supports the evidence<br>Einstein's conclusion about the flow of time | 4<br>9<br>19<br>43<br>64<br>94<br>139<br>186 | formulate a hypothesis<br>write a hypothesis<br>how do your observations support your answer?<br>develop a hypothesis<br>construct a reasonable explanation<br>propose a relationship between power and voltage<br>state a hypothesis about period of pendulum<br>explain how your observations support or refute the hypothesis |
| 11.A.4b<br>Scientific Inquiry | Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems. | Know and apply the concepts, principles and processes of scientific inquiry. | Conduct controlled experiments or simulations to test hypotheses. | 6<br>8<br>8<br>8<br>24      | what is a variable<br>independent variables<br>dependent variables<br>control and experimental variables<br>importance of changing one variable at a time in an experiment             | 9<br>9<br>64<br>139                          | identify experimental and controlled variables<br>design a valid experiment by changing only one variable at a time<br>conduct the experiment you designed<br>investigate variables and how they affect the period of a pendulum   |

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|-------------------------------|---|--|--|--------------------|--|---------------------|--|
| 11.A.4c<br>Scientific Inquiry | Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems. | Know and apply the concepts, principles and processes of scientific inquiry. | Collect, organize and analyze data accurately and precisely. | 9                  | scientific evidence and data tables              | 2                   | accuracy, resolution, and precision                  |
|                               |   |  |  | 25                 | constructing a graph                             | 6                   | create a graph of the car's speed vs. position       |
|                               |   |  |  | 26                 | study the data table (#7)                        | 12                  | analyze the graphical models                         |
|                               |   |  |  | 28                 | make a data table (#6)                           | 18                  | constant force data table                            |
|                               |   |  |  | 38                 | motion graphs                                    | 19                  | constant height data table                           |
|                               |   |  |  | 40                 | motion graphs                                    | 22                  | create and analyze a second law of motion graph      |
|                               |   |  |  | 51                 | create a data table (#1)                         | 39                  | create a graph of force vs. extension for the spring |
|                               |   |  |  | 52                 | create a data table (#4)                         | 43                  | create a data table for all measurements             |
|                               |   |  |  | 108                | using a graph to find force vector components    | 58                  | force vs. distance data table                        |
|                               |   |  |  | 431                | harmonic motion graphs                           | 59                  | graph work done vs. deflection of rubber band        |
|                               |   |  |  | 432                | finding the amplitude on a harmonic motion graph | 60                  | graph speed vs. rubber band deflection               |
|                               |   |  |  |                    |  | 62                  | make a graph of efficiency vs. speed                 |
|                               |   |  |  |                    |  | 64                  | analyze the results                                  |
|                               |   |  |  |                    |  | 83                  | construct a graph                                    |
|                               |   |  |  |                    |  | 111                 | graph current vs. time for the capacitor             |

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|-------------------------------|---|--|---|--------------------|---|--|--|
|                               |   |  |   |                    |   | 116 estimate the precision of measurements<br>126 graph voltage vs. speed<br>139 sketch harmonic motion graphs |  |
| 11.A.4d<br>Scientific Inquiry | Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems. | Know and apply the concepts, principles and processes of scientific inquiry. | Apply statistical methods to the data to reach and support conclusions. | 4<br>38<br>42      | what is analysis<br>slope of a position vs. time graph<br>slope of a speed vs. time graph | 7<br>22<br>49<br>83<br>107   | find percent error<br>find the slope of the line and determine its significance in the experiment<br>find the average range of the launched marble<br>find a percentage<br>find the average of the three times |

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|-------------------------------|---|--|---|--------------------|--|---------------------|---|
| 11.A.4e<br>Scientific Inquiry | Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems. | Know and apply the concepts, principles and processes of scientific inquiry. | Formulate alternative hypotheses to explain unexpected results. | 8                  | formulating a hypothesis                     | 4                   | formulate a hypothesis  |
|                               |   |  |   | 10                 | what is a model                              | 6                   | how does prediction compare with measurement?                   |
|                               |   |  |   | 196                | the evidence supports the conclusion         | 9                   | write a hypothesis  |
|                               |   |  |   | 244                | draw a conclusion that supports the evidence | 19                  | how do your observations support your answer?                   |
|                               |   |  |   | 280                | Einstein's conclusion about the flow of time | 30                  | comparing predicted velocities to measured velocities           |
|                               |   |  |   |                    |  | 37                  | how did your measured acceleration compare with the prediction? |
|                               |   |  |   |                    |  | 43                  | develop a hypothesis  |
|                               |   |  |   |                    |  | 64                  | construct a reasonable explanation                              |
|                               |   |  |   |                    |  | 94                  | propose a relationship between power and voltage                |
|                               |   |  |   |                    |  | 139                 | state a hypothesis about period of pendulum                     |
|                               |   |  |   |                    |  | 186                 | explain how your observations support or refute the hypothesis  |

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|-------------------------------|---|--|--|--------------------|-------------------------------------|---------------------|---|
| 11.A.4f<br>Scientific Inquiry | Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems. | Know and apply the concepts, principles and processes of scientific inquiry. | Using available technology, report, display and defend to an audience conclusions drawn from investigations. | 11                 | importance of units                 |                     |   |
|                               |   |  |  | 11                 | communicating via measurement       |                     | each investigation contains a "thinking about what you observed" section, and students must be able to communicate and defend their findings from the investigation |
|                               |   |  |  | 28                 | prepare a written report (#3, 4, 8) |                     |   |
|                               |   |  |  | 213                | prepare a written report (#1)       |                     |   |
|                               |   |  |  | 241                | prepare a written report (#3, 5)    | 76                  | what is the best way to present your results?   |
|                               |   |  |  | 272                | prepare a written report (#5)       | 102                 | explain what happened   |
|                               |   |  |  | 359                | research and report (#3)            | 180                 | present what you have learned   |
|                               |   |  |  | 463                | research and report (#5)            |                     |   |
|                               |   |  |  | 542                | research and report (#6)            |                     |   |

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|---------------------------------|---|--|--|--------------------|---|---------------------|---|
| 11.B.4a<br>Technological Design | Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems. | Know and apply the concepts, principles and processes of technological design. | Identify a technological design problem inherent in a commonly used product. | 20                 | identify what you are being asked to do | 53                  | propose a solution to the lever mystery                                 |
|                                 |   |  |  | 96                 | gathering forensic information          | 76                  | identify what you want to improve before you design the solution        |
|                                 |   |  |  | 440                | identifying problems with Hancock tower | 76                  | what can you do to demonstrate heat transfer by radiation?              |
|                                 |   |  |  |                    |   | 121                 | be clear about goals of engineering project                             |
|                                 |   |  |  |                    |   | 121                 | steps in the engineering design cycle                                   |
|                                 |   |  |  |                    |   | 126                 | what could you do to change the performance of the generator you built? |
|                                 |   |  |  |                    |   | 127                 | build different generators  |

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|---------------------------------|---|--|--|--------------------|--|---------------------|---|
| 11.B.4b<br>Technological Design | Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems. | Know and apply the concepts, principles and processes of technological design. | Propose and compare different solution designs to the design problem based upon given constraints including available tools, materials and time. | 187                | building a prototype windmill            | 53                  | design and test a solution to the lever mystery                 |
|                                 |   |  |  | 382                | building your own compass (#3)           | 76                  | design and test a way to demonstrate heat transfer by radiation |
|                                 |   |  |  | 518                | design an improvement for a product (#9) | 121                 | design a maglev train model                                     |
|                                 |   |  |  |                    |  | 126                 | implement your generator design change ideas                    |
|                                 |   |  |  |                    |  | 127                 | try your design change ideas                                    |
|                                 |   |  |  |                    |  | 127                 | building different generators                                   |

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|---------------------------------|---|--|--|--------------------|--|---------------------|---|--|
| 11.B.4c<br>Technological Design | Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems. | Know and apply the concepts, principles and processes of technological design. | Develop working visualizations of the proposed solution designs (e.g., blueprints, schematics, flowcharts, cad-cam, animations). | 11                 | importance of units                              |                     | each investigation contains a "thinking about what you observed" section, and students must be able to communicate and defend their findings from the investigation |  |
|                                 |   |  |  | 11                 | communicating via measurement                    |                     |   |  |
|                                 |   |  |  | 25                 | constructing a graph                             |                     |   |  |
|                                 |   |  |  | 38                 | motion graphs                                    |                     |   |  |
|                                 |   |  |  | 40                 | motion graphs                                    |                     |   |  |
|                                 |   |  |  | 108                | using a graph to find force vector components    | 6                   |   | create a graph of the car's speed vs. position       |
|                                 |   |  |  | 431                | harmonic motion graphs                           | 12                  |   | analyze the graphical models                         |
|                                 |   |  |  | 432                | finding the amplitude on a harmonic motion graph | 22                  |   | create and analyze a second law of motion graph      |
|                                 |   |  |  |                    |  | 39                  |   | create a graph of force vs. extension for the spring |
|                                 |   |  |  |                    |  | 59                  |   | graph work done vs. deflection of rubber band        |
|                                 |   |  |  |                    |  | 60                  |   | graph speed vs. rubber band deflection               |
|                                 |   |  |  |                    |  | 62                  |   | make a graph of efficiency vs. speed                 |
|                                 |   |  |  |                    |  | 64                  |   | create an energy flow diagram                        |
|                                 |   |  |  |                    |  | 76                  | what is the best way to present your results?   |  |
|                                 |   |  |  |                    |  | 83                  | construct a graph   |  |



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|---------------------|------------|-------------------|----------------------|--------------------|--------|---|--------|
|                     |            |                   |                      |                    |        | 111 graph current vs. time for the capacitor<br>126 graph voltage vs. speed<br>139 sketch harmonic motion graphs<br>180 present what you have learned |        |

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|------------------------------------|---|--|--|--------------------|--|---------------------|--|
| 11.B.4d<br>Technological<br>Design | Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems. | Know and apply the concepts, principles and processes of technological design. | Determine the criteria upon which the designs will be judged, identify advantages and disadvantages of the designs and select the most promising design. | 20                 | identify what you are being asked to do              | 53                  | design and test a solution to the lever mystery                  |
|                                    |   |  |  | 96                 | gathering forensic information                       | 53                  | propose a solution to the lever mystery                          |
|                                    |   |  |  | 187                | building a prototype windmill                        | 64                  | suggest a design modification                                    |
|                                    |   |  |  | 382                | building your own compass (#3)                       | 76                  | what can you do to demonstrate heat transfer by radiation?       |
|                                    |   |  |  | 440                | identifying problems with Hancock tower              | 76                  | design and test a way to demonstrate heat transfer by radiation  |
|                                    |   |  |  | 441                | improving the Hancock tower design                   | 76                  | evaluate the success of your heat transfer model                 |
|                                    |   |  |  | 478                | improving acoustics in a concert hall                | 76                  | identify what you want to improve before you design the solution |
|                                    |   |  |  | 512                | improvements made possible by charge-coupled devices | 121                 | steps in the engineering design cycle                            |
|                                    |   |  |  | 518                | design an improvement for a product (#9)             | 121                 | suggest improvements you could make to the model                 |
|                                    |   |  |  | 537                | improving retinal implants                           | 121                 | design a maglev train model                                      |
|                                    |   |  |  |                    |  | 121                 | compare and evaluate models                                      |
|                                    |   |  |  |                    |  | 121                 | be clear about goals of engineering project                      |

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|---------------------|------------|-------------------|----------------------|--------------------|--------|---------------------|---|
|                     |            |                   |                      |                    |        | 126                 | what could you do to change the performance of the generator you built? |
|                     |            |                   |                      |                    |        | 126                 | what changes have the largest effect on voltage produced?               |
|                     |            |                   |                      |                    |        | 126                 | implement your generator design change ideas                            |
|                     |            |                   |                      |                    |        | 126                 | explain and communicate your findings                                   |
|                     |            |                   |                      |                    |        | 127                 | build different generators  |
|                     |            |                   |                      |                    |        | 127                 | try your design change ideas  |
|                     |            |                   |                      |                    |        | 127                 | explain the relationship between voltage and magnet configuration       |
|                     |            |                   |                      |                    |        | 127                 | evaluate the effects your design change produced                        |
|                     |            |                   |                      |                    |        | 127                 | measure voltage for each different generator                            |
|                     |            |                   |                      |                    |        | 127                 | building different generators   |

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|---------------------------------|---|--|---|--------------------|---|---------------------|---|
| 11.B.4e<br>Technological Design | Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems. | Know and apply the concepts, principles and processes of technological design. | Develop and test a prototype or simulation of the solution design using available materials, instruments and technology | 20                 | identify what you are being asked to do | 53                  | propose a solution to the lever mystery                                 |
|                                 |   |  |   | 96                 | gathering forensic information          | 76                  | identify what you want to improve before you design the solution        |
|                                 |   |  |   | 440                | identifying problems with Hancock tower | 76                  | what can you do to demonstrate heat transfer by radiation?              |
|                                 |   |  |   |                    |   | 121                 | be clear about goals of engineering project                             |
|                                 |   |  |   |                    |   | 126                 | what could you do to change the performance of the generator you built? |
|                                 |   |  |   |                    |   | 127                 | build different generators  |

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|------------------------------------|---|--|--|--------------------|--|---------------------|--|
| 11.B.4f<br>Technological<br>Design | Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems. | Know and apply the concepts, principles and processes of technological design. | Evaluate the test results based on established criteria, note sources of error and recommend improvements. | 20                 | identify what you are being asked to do              | 53                  | design and test a solution to the lever mystery                  |
|                                    |   |  |  | 96                 | gathering forensic information                       | 53                  | propose a solution to the lever mystery                          |
|                                    |   |  |  | 187                | building a prototype windmill                        | 64                  | suggest a design modification                                    |
|                                    |   |  |  | 382                | building your own compass (#3)                       | 76                  | what can you do to demonstrate heat transfer by radiation?       |
|                                    |   |  |  | 440                | identifying problems with Hancock tower              | 76                  | design and test a way to demonstrate heat transfer by radiation  |
|                                    |   |  |  | 441                | improving the Hancock tower design                   | 76                  | evaluate the success of your heat transfer model                 |
|                                    |   |  |  | 478                | improving acoustics in a concert hall                | 76                  | identify what you want to improve before you design the solution |
|                                    |   |  |  | 512                | improvements made possible by charge-coupled devices | 121                 | steps in the engineering design cycle                            |
|                                    |   |  |  | 518                | design an improvement for a product (#9)             | 121                 | suggest improvements you could make to the model                 |
|                                    |   |  |  | 537                | improving retinal implants                           | 121                 | design a maglev train model                                      |
|                                    |   |  |  |                    |  | 121                 | compare and evaluate models                                      |
|                                    |   |  |  |                    |  | 121                 | be clear about goals of engineering project                      |

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|---------------------|------------|-------------------|----------------------|--------------------|--------|---------------------|---|
|                     |            |                   |                      |                    |        | 126                 | what could you do to change the performance of the generator you built? |
|                     |            |                   |                      |                    |        | 126                 | what changes have the largest effect on voltage produced?               |
|                     |            |                   |                      |                    |        | 126                 | implement your generator design change ideas                            |
|                     |            |                   |                      |                    |        | 126                 | explain and communicate your findings                                   |
|                     |            |                   |                      |                    |        | 127                 | build different generators  |
|                     |            |                   |                      |                    |        | 127                 | try your design change ideas  |
|                     |            |                   |                      |                    |        | 127                 | explain the relationship between voltage and magnet configuration       |
|                     |            |                   |                      |                    |        | 127                 | evaluate the effects your design change produced                        |
|                     |            |                   |                      |                    |        | 127                 | measure voltage for each different generator                            |
|                     |            |                   |                      |                    |        | 127                 | building different generators   |

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|------------------------------------|---|--|--|--------------------|-------------------------------------|---------------------|---|
| 11.B.4g<br>Technological<br>Design | Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems. | Know and apply the concepts, principles and processes of technological design. | Using available technology, report to an audience the relative success of the design based on the test results and criteria. | 11                 | importance of units                 |                     |   |
|                                    |   |  |  | 11                 | communicating via measurement       |                     | computer spreadsheets and graphing software can be used throughout the curriculum for data analysis and presentation  |
|                                    |   |  |  | 28                 | prepare a written report (#3, 4, 8) |                     | each investigation contains a "thinking about what you observed" section, and students must be able to communicate and defend their findings from the investigation |
|                                    |   |  |  | 213                | prepare a written report (#1)       |                     |   |
|                                    |   |  |  | 241                | prepare a written report (#3, 5)    |                     |   |
|                                    |   |  |  | 272                | prepare a written report (#5)       |                     |   |
|                                    |   |  |  | 359                | research and report (#3)            | 76                  | what is the best way to present your results?   |
|                                    |   |  |  | 463                | research and report (#5)            |                     |   |
|                                    |   |  |  | 542                | research and report (#6)            | 180                 | present what you have learned   |

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|--------------------------------|--|--|---|--------------------|--|---------------------|--|
| 12.C.4a<br>Physical<br>Science | Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences. | Know and apply concepts that describe properties of matter and energy and the interactions between them. | Use kinetic theory, wave theory, quantum theory and the laws of thermodynamics to explain energy transformations. | 194                | energy and systems                                   | 62                  | describe energy changes                            |
|                                |  |  |   | 195                | energy exists in many different forms                | 63                  | trace the energy flow of the system                |
|                                |  |  |   | 197                | energy flow diagrams                                 | 63                  | investigate energy flow in a system                |
|                                |  |  |   | 205                | energy flow in natural systems                       | 64                  | identify forms of energy in an experimental system |
|                                |  |  |   | 226                | flow of thermal energy is heat                       | 80                  | absorption and emission of light by electrons      |
|                                |  |  |   | 227                | heat and work  | 91                  | draw energy flow diagram of the circuit            |
|                                |  |  |   | 235                | heat transfer is everywhere                          | 184                 | investigate phosphorescence                        |
|                                |  |  |   | 251                | absorption and emission of light by atomic electrons |                     |  |
|                                |  |  |   | 252                | explaining spectral lines                            |                     |  |
|                                |  |  |   | 448                | waves transmit energy                                |                     |  |
|                                |  |  |   | 449                | waves and technology                                 |                     |  |
|                                |  |  |   | 461                | waves and energy                                     |                     |  |
|                                |  |  |   | 556                | atoms and photons                                    |                     |  |
|                                |  |  |   | 557                | atoms absorb and emit light                          |                     |  |



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|--------------------------------|--|--|---|--------------------|------------------------------------|---------------------|------------------|
| 12.C.4b<br>Physical<br>Science | Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences. | Know and apply concepts that describe properties of matter and energy and the interactions between them. | Analyze and explain the atomic and nuclear structure of matter. | 246                | subatomic particles and charge     | 77                  | atomic structure |
|                                |  |  |   | 246                | protons and neutrons and electrons |                     |                  |
|                                |  |  |   | 247                | weak force explained               |                     |                  |
|                                |  |  |   | 249                | radioactive decay                  |                     |                  |
|                                |  |  |   | 252                | the Bohr model and electron shells |                     |                  |
|                                |  |  |   | 258                | fusion reactions                   |                     |                  |
|                                |  |  |   | 259                | fission reactions                  |                     |                  |
|                                |  |  |   | 259                | radioactive materials              |                     |                  |
|                                |  |  |   | 343                | electrons and picture tubes        |                     |                  |
|                                |  |  |   | 347                | electron motion and current        |                     |                  |

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|--------------------------------|--|--|--|--------------------|---|---------------------|--|
| 12.D.4a<br>Physical<br>Science | Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences. | Know and apply concepts that describe force and motion and the principles that explain them. | Explain and predict motions in inertial and accelerated frames of reference. | 17                 | speed of light                                  | 3                   | speed defined and calculated                     |
|                                |  |  |  | 17                 | constant speed                                  | 4                   | measure the speed of the car                     |
|                                |  |  |  | 17                 | speed defined                                   | 11                  | compare and contrast speed and velocity          |
|                                |  |  |  | 18                 | calculating speed                               | 14                  | create and study a velocity vs. time graph       |
|                                |  |  |  | 18                 | speed units                                     | 16                  | collect data to calculate the car's acceleration |
|                                |  |  |  | 19                 | velocity defined                                | 17                  | create and study a velocity vs. time graph       |
|                                |  |  |  | 35                 | acceleration of sports cars                     | 18                  | investigate Newton's first law of motion         |
|                                |  |  |  | 35                 | acceleration defined                            | 19                  | why did the speed change?                        |
|                                |  |  |  | 37                 | acceleration and velocity                       | 20                  | second law of motion                             |
|                                |  |  |  | 37                 | calculating acceleration                        | 21                  | Newton's second law and the Atwood's machine     |
|                                |  |  |  | 38                 | position vs. time graphs                        | 21                  | investigate second law of motion                 |
|                                |  |  |  | 39                 | position vs. time graph for accelerating motion | 25                  | investigate Newton's 3rd law                     |
|                                |  |  |  | 40                 | speed vs. time graph                            | 26                  | find the speed of the car                        |
|                                |  |  |  | 41                 | speed vs. time graph for accelerating motion    | 31                  | investigate Newton's 3rd law of motion           |
|                                |  |  |  | 43                 | finding distance from a speed vs. time graph    | 35                  | using Newton's second law                        |
|                                |  |  |  | 54                 | force defined                                   |                     |  |
|                                |  |  |  | 55                 | Newton's first law                              |                     |  |
|                                |  |  |  | 57                 | net force explained                             |                     |  |
|                                |  |  |  | 59                 | quantitative understanding of second law        |                     |  |
|                                |  |  |  | 59                 | Newton's second law                             |                     |  |

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**Student Text and Investigation Manual**

| Standard #:<br>Area | State Goal | Learning Standard | Learning Expectation | student text<br>pg | detail                                | investigation<br>pg | detail   |
|---------------------|------------|-------------------|----------------------|--------------------|---------------------------------------|---------------------|--|
|                     |            |                   |                      | 60                 | balanced and unbalanced forces        | 42                  | investigate sliding friction                   |
|                     |            |                   |                      | 60                 | applying Newton's second law properly | 49                  | find the launch speed of the marble            |
|                     |            |                   |                      | 61                 | net force and second law calculating  | 60                  | measure speed of car                           |
|                     |            |                   |                      | 61                 | using second law formula              | 61                  | experiment and find average speed              |
|                     |            |                   |                      | 64                 | acceleration of falling objects       | 62                  | graph efficiency vs. speed                     |
|                     |            |                   |                      | 64                 | velocity defined                      | 62                  | investigate the efficiency of the car launcher |
|                     |            |                   |                      | 69                 | effects of air resistance             | 62                  | investigate efficiency                         |
|                     |            |                   |                      | 69                 | terminal speed                        | 63                  | measure speed of car                           |
|                     |            |                   |                      | 69                 | skydiving and terminal speed          |                     |  |
|                     |            |                   |                      | 77                 | Newton's third law                    |                     |  |
|                     |            |                   |                      | 78                 | sorting out force pairs               |                     |  |
|                     |            |                   |                      | 113                | when net force is zero                |                     |  |
|                     |            |                   |                      | 114                | Newton's third law and springs        |                     |  |
|                     |            |                   |                      | 117                | friction explained                    |                     |  |
|                     |            |                   |                      | 117                | cause of friction                     |                     |  |
|                     |            |                   |                      | 118                | static and sliding friction           |                     |  |
|                     |            |                   |                      | 120                | reducing friction                     |                     |  |
|                     |            |                   |                      | 121                | useful friction                       |                     |  |

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|---------------------|------------|-------------------|-------------------------|--------------------|---|---------------------|--------|
|                     |            |                   |                         | 126                | the third law and physics of walls        |                     |        |
|                     |            |                   |                         | 136                | speed vs. velocity                        |                     |        |
|                     |            |                   |                         | 143                | angular speed                             |                     |        |
|                     |            |                   |                         | 149                | acceleration and circular motion          |                     |        |
|                     |            |                   |                         | 176                | friction and machines                     |                     |        |
|                     |            |                   |                         | 183                | friction explained                        |                     |        |
|                     |            |                   |                         | 196                | generation of heat from frictional motion |                     |        |
|                     |            |                   |                         | 332                | efficiency of gasoline engine             |                     |        |
|                     |            |                   |                         | 332                | efficiency of electric motors             |                     |        |
|                     |            |                   |                         | 430                | friction and damping                      |                     |        |
|                     |            |                   |                         | 436                | Newton's second law and oscillators       |                     |        |

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|---------------------------------|--|--|--|--|--|---------------------|--|
| 12.D.4b<br>Physical Science     | Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences. | Know and apply concepts that describe force and motion and the principles that explain them. | Describe the effects of electromagnetic and nuclear forces including atomic and molecular bonding, capacitance and nuclear reactions | 247<br>247<br>249<br>256<br>257<br>258<br>259<br>259 | electromagnetic and strong force<br>weak force explained<br>radioactive decay<br>nuclear reactions explained<br>nuclear reactions and energy<br>fusion reactions<br>fission reactions<br>radioactive materials | 78                  | find mass number of specific isotope   |
| 13.A.4a<br>Practices of Science | Understand the relationships among science, technology and society in historical and contemporary contexts.          | Know and apply the accepted practices of science.  | Estimate and suggest ways to reduce the degree of risk involved in science activities.   |  | Lab safety symbols and instructions are found in the investigation manual on the page before TOC   |                     | featured throughout CPO Science program<br>102 short circuits and lab safety<br>106 capacitor safety |

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|---------------------------------|---|---|--|------------------------------|--|--|--|
| 13.A.4b<br>Practices of Science | Understand the relationships among science, technology and society in historical and contemporary contexts. | Know and apply the accepted practices of science. | Assess the validity of scientific data by analyzing the results, sample set, sample size, similar previous experimentation, possible misrepresentation of data presented and potential sources of error. | 10                           | what is a model  | 2<br>6<br>7<br>7<br>30<br>37<br>60<br>83 | accuracy, resolution, and precision<br>how does prediction compare with measurement?<br>find percent error<br>find percent error<br>comparing predicted velocities to measured velocities<br>how did your measured acceleration compare with the prediction?<br>how close is your prediction to the actual measurement?<br>find a percentage |
| 13.A.4c<br>Practices of Science | Understand the relationships among science, technology and society in historical and contemporary contexts. | Know and apply the accepted practices of science. | Describe how scientific knowledge, explanations and technological designs may change with new information over time (e.g., the understanding of DNA, the design of computers).                           | 22<br>22<br>54<br>244<br>245 | discovery of Penicillin<br>Fleming's investigations<br>Newton's idea of force<br>atomic theory<br>development of atom models |  |  |

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|---|---|--|---|--------------------|--|---------------------|--|
| 13.A.4d<br>Practices of<br>Science                | Understand the relationships among science, technology and society in historical and contemporary contexts. | Know and apply the accepted practices of science.  | Explain how peer review helps to assure the accurate use of data and improves the scientific process. | 23                 | science helps us learn about natural world | 18<br>31            | investigating the law of inertia<br>investigating momentum and the third law |
| 13.B.4a<br>Science,<br>Technology,<br>and Society | Understand the relationships among science, technology and society in historical and contemporary contexts. | Know and apply concepts that describe the interaction between science, technology and society. | Compare and contrast scientific inquiry and technological design as pure and applied sciences.        | 120                | maglev train technology                    | 168                 | research how computer monitors and televisions make colors                   |

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| Standard #:<br>Area                               | State Goal  | Learning Standard  | Learning Expectation  | student text<br>pg  | detail   | investigation<br>pg | detail                            |
|---|---|--|---|---|--|---------------------|-----------------------------------|
| 13.B.4b<br>Science,<br>Technology,<br>and Society | Understand the relationships among science, technology and society in historical and contemporary contexts. | Know and apply concepts that describe the interaction between science, technology and society. | Analyze a particular occupation to identify decisions that may be influenced by a knowledge of science. | 22<br>96<br>126<br>127<br>132<br>209<br>277<br>287<br>332<br>535<br>559 | bacteriologist<br>forensic engineer<br>science, engineering, and architecture<br>science and architecture<br>civil engineer (# 3)<br>tidal power is an active area of engineering research<br>physicists have built special experiments to capture and study neutrinos<br>a challenge for physicists<br>automobile engineer and hybrid cars<br>recording images<br>geophysicists |                     |                                   |
| 13.B.4c<br>Science,<br>Technology,<br>and Society | Understand the relationships among science, technology and society in historical and contemporary contexts. | Know and apply concepts that describe the interaction between science, technology and society. | Analyze ways that resource management and technology can be used to accommodate population trends.      | 90  | energy usage and conservation  | 83                  | radioactivity and the environment |



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|---|---|--|--|--------------------|---|---------------------|--|
| 13.B.4d<br>Science,<br>Technology,<br>and Society | Understand the relationships among science, technology and society in historical and contemporary contexts. | Know and apply concepts that describe the interaction between science, technology and society. | Analyze local examples of resource use, technology use or conservation programs; document findings; and make recommendations for improvements. | 90                 | energy usage and conservation                             |                     |  |
| 13.B.4e<br>Science,<br>Technology,<br>and Society | Understand the relationships among science, technology and society in historical and contemporary contexts. | Know and apply concepts that describe the interaction between science, technology and society. | Evaluate claims derived from purported scientific studies used in advertising and marketing strategies.  | 103<br>314         | analyzing a nutrition label<br>analyze an appliance label | 180                 | analyze industrial use of a type of electromagnetic wave |