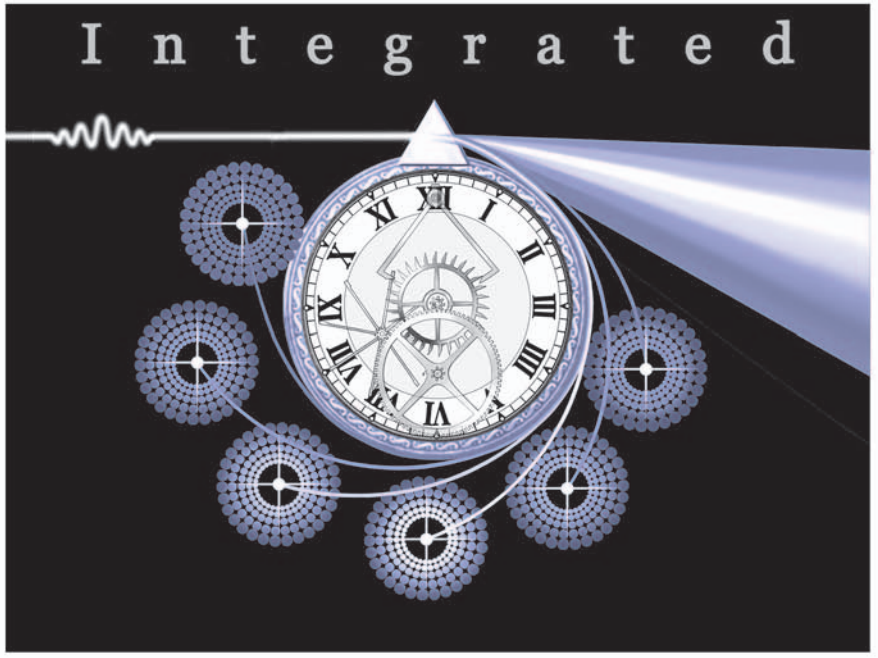

Physics and Chemistry

Tom Hsu, Ph.D.

FIRST EDITION
Cambridge Physics Outlet
Peabody, Massachusetts 01960

The cover is an evocative montage of historic scientific achievements that demonstrate the incredible persistence of the human intellect. Around the border, DaVinci's graphics represent the start of an evolving tapestry of conceptual thinking. His fantastical mechanisms become the modern bicycle, a quintessential machine, which rolls into a graphical interpretation of wavelength division multiplexing on a fiber optic. These images follow 500 years of scientific and technological innovation. The Earth and DNA serve to remind us that this technological innovation will always remain deeply connected to the natural world. On the back cover, the elegant geometry of the chambered nautilus folds into a spiral defined by the Golden Rectangle. The interplay of organic and architectural forms represents the balance we seek between the power of technology and the fragility of our lives and our world. I hope this colorful interplay of images will inspire interest and excitement about the discovery of science.

Bruce Holloway - Senior Creative Designer

CPO Integrated Physics and Chemistry

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The CPO Science Program

"The whole of science is nothing more than a refinement of everyday thinking."

Albert Einstein

One of the great scientists in history, Albert Einstein stated, "The whole of science is nothing more than a refinement of everyday thinking." This great thinker and theorist explained that science is not just the memorization of complex facts or the rote learning of complicated ideas but a process by which we discover and explore the things, concepts, and mysteries we see around us.

The CPO Integrated Physics and Chemistry Program is created from the premise that science is an exploration and discovery of ideas about the universe, and that ideas and knowledge connect and enhance our lives. The program is presented and sequenced in a way that moves the student through an inquiry-based learning approach. Each chapter and Investigation begin with key questions that form the foundation for the learning. In many sections, student complete experiments and hands-on activities before conceptualizing ideas in the student readings. Threaded throughout all the instruction are probing questions that students answer through exploration, posing new questions, finding data to prove theories, and expressing their findings to others.

The CPO Science Program correlates to Texas Essential Knowledge and Skills

Unlike other textbooks that match content to National Science Education Standards, the CPO Science Program was written directly from the Texas Essential Knowledge and Skills (TEKS). The TEKS form the benchmark criteria from which each science topic, specific content requirement, and science process was developed. The program provides numerous opportunities for students, teachers, and schools to meet the TEKS Standards. Matching the TEKS to CPO Unit topics ensures that students will receive the highest quality in science instruction to the depth and breadth necessary to meet your teaching needs.

The TEKS Index included in this reference volume demonstrates the alignment between Texas Essential Knowledge and Skills standards and the CPO Science Program. The TEKS are listed with specific page numbers from the CPO Student Edition and Investigation Lab Manual where examples of correlations are found. An example of the CPO Scope and Sequence guide also found in the teacher's guide demonstrates the careful consideration and detail of content match between the Student Edition and accompanying Investigations. These charts can be reviewed as a quick reference to the teaching and learning objectives covered in this program.

Meeting all students' needs

Learning science is an active process allowing students to gain abstract, conceptual knowledge through discovery. Most students learn best when reading is enhanced by doing. The CPO Science Program combines strong, in-depth coverage of physics and chemistry content with abundant hands-on learning activities to meet the variety of learning styles. Real-world examples and historical perspectives provide students the authenticity that validates their connection to the content and topics. Teaching tips are found in the teacher's guide as suggestions for remediation and skill development practice with challenge problems for students who are prepared to tackle more difficult concepts.

The Multilevel Classroom of Today

Classrooms are composed of learners who are at different instructional levels and who process information through multiple learning styles. The CPO Science Program has been designed to meet the challenge of bringing in-depth, accurate science to all students. To teach in-depth science concepts and skills, the design of the Student Edition reflects instructional aids and strategies to meet that diversity of student needs. Careful consideration has been taken to include reading, math, and learning techniques to help all students grasp science concepts and skills.

Reading and concept-learning strategies

Main idea indicators — Main idea indicators appear in the left margin of each paragraph in the Student Edition to help students find information and understand the main concepts in the instruction. Students can use the indictors in the following ways:

- Read all the main idea indicators before reading the section as a pre-reading activity.
- List the major points of the section.
- Create outlines and concept maps.
- Find answers to questions by skimming and scanning the indicators for a quick review.

Highlighted vocabulary — As in any discipline or occupation, people must understand the subject's terminology and know how to use it correctly. Terms, units of measurement, and concepts are highlighted in blue for students to easily identify key words as reading clues and for vocabulary development.

Bold highlighted points — Major scientific concepts, vocabulary, and laws appear in large print and blue type. These statements identify the major learning points and what to review when studying.

Building problem-solving skills by using key questions

Asking questions before starting an activity focuses students on what they will learn during the experiment or reading. Each Investigation begins with a key question that students need to answer after the activity. Students build problem-solving and critical thinking skills as they tackle each Investigation question. The following is a suggested sequence to use when deciphering questions:

- Have the student reread the question.
- Underline the action words and explain what is being asked.
- Identify the important words (usually vocabulary words).
- Have the students rewrite the question in their own words.
- Help students decide what they will need to know in order to answer the question.

Reading illustration and graphics for science concepts

Some students learn best through visual clues and illustrations. Others need the dual support of text and visual clues in order to comprehend science concepts and theories. Our student text and Investigations manual have numerous content-rich illustrations, charts, tables, and graphics. Suggestions for using the visual clues include:

- Give students enough time to analyze the graphics and illustrations. Decoding the meaning of a visual is like reading text.
- Ask the students to verbally explain what they see in the graphic and what is being demonstrated.
- Teach students to read data tables and graphs so that they understand how to organize and represent data. Numerous examples and questions requiring completion of tables are presented with explanations.
- In teams, have students illustrate a concept or create graphics for the section. Other team members decide which concept or section is being illustrated.

Reading, understanding, and using math formulas

Formulas help students describe relationships between quantities. After students understand the basis for formulas and how they represent relationships, they can use them as tools for solving problems or predicting outcomes. We emphasize understanding relationships rather than simply memorizing formulas.

- Math formulas are connected to the data collection process during hands-on activities. The formulas are all in the context of the Investigation, and as a result, students apply math formulas to actual science experiences.

Important math formulas are highlighted, written in large print, and also explained in the text.

- Example problems illustrate how to use the formula and how it can be applied to the most common situations. Students' learning of the formulas is reinforced throughout the Student Edition and in the assessment sections.
- Only the most relevant math formulas are presented in the text and explained in depth.
- A reference section in the Student Edition contains an easy-to-read table of all the formulas in the program.

Expressing learning in a variety of ways

Students learn differently and use various avenues for expressing their knowledge. In the review questions in the Student Edition, students are asked to answer *Applying Your Knowledge* questions. These questions allow students to express their knowledge and demonstrate learning in several modalities. Examples include designing an experiment, researching information, building a model, writing an essay, checking appliances in their homes, preparing a pamphet or brochure, discussing ideas, creating sketches, forming a committee to develop plans, interviewing someone, creating a handout for young children, and using the Internet.

Evaluation and Assessment

"Anyone who has never made a mistake has never tried anything new."

Albert Einstein

The CPO Science Program is committed to presenting material in a variety of ways to meet the diversity of student learning styles. Students learn in a combination of modalities and demonstrate understanding through a variety of modes. A combination of evaluation methods is available to ensure multilevel and diverse opportunities. A variety of methods is necessary in order for students to demonstrate science content knowledge, application skills, performance abilities, and scientific process and problem-solving skills to the best of their ability. Below are descriptions of the different evaluation and assessment instruments.

Evaluating with review questions — formative assessment

Review questions are found at the end of each chapter to evaluate student progress and reflect on key chapter objectives. These questions provide opportunities to test and practice vocabulary, concept knowledge, skill understanding, computational ability, problem solving, and application. Many questions require a written response in order to better evaluate the student's abstract understanding. The review questions are a useful teaching tool to benchmark individual progress and to aid class discussions that review and reflect on chapter objectives.

Assessing broader knowledge with assessment questions — summative assessment

The assessment questions have been carefully designed to test all the important topic knowledge covered in a unit. The assessment questions evaluate the student's knowledge of the TEKS that correlate with the unit. Included in the questions are examples of graphs, charts, and computational information needed to answer questions and demonstrate application skills. The assessment questions are on the Examview CD and consist of multiple choice and multi-format questions that cover computation, skill attainment, and concept understanding. These questions are designed to reflect typical standardized test questions. Exposure and practice in answering multiple-choice type questions has proved helpful to students in states using formal standardized testing. There are over 800 questions on the Examview CD.

Learning and applying skills — performance assessment

Being able to justify conclusions based on active experimentation and data collection is a powerful skill in today's technological world. Performance assessment measures how well a student can solve problems and demonstrate understanding through application. The CPO Science Program builds the self-confidence that students need to tackle problems in a thoughtful and sequenced manner.

An Investigation is completed with each teacher's guide section and includes questions and activities that allow teachers to observe the students' ability to think and demonstrate understanding. Most Investigations rely on team participation and hands-on learning. Students are continuously exposed to a systematic problem-solving method that encourages students to discover, observe, collect data and justify findings. A sample observation evaluation form is provided in the *Strategies and Tables* section of the reference volume to help determine the students' progress with performance tasks. A student reflection form can be found in the *Skills Sheet* section.

Organization of the Program

"Hear and you forget; see and you remember; do and you understand."

Confucius

The program is composed of four components: Student Edition, Investigations, Teacher's Guides, and Equipment. These components reflect the connections between inquiry-based learning, hands-on discovery, and grasping science concepts through reading. Abstract concepts and skill development opportunities are presented in a variety of ways to address diverse and multiple learning styles. Enhancing the instruction are clear, precise illustrations that reinforce the learning of abstract concepts. By the end of each section, students have completed a hands-on activity or experiment, answered essential questions, and mastered science skills and content through reading.

The Teacher's Guide and support materials have been divided into six volumes: one reference and five content topic guides. The reference volume contains: the glossary, index, assessment questions and answers, review answer keys, skill sheets, and other reference tables. The five content topic teacher's guides provide sample lessons that demonstrate how to teach each lesson with accompanying Investigation sheets and answers. Teaching tips, challenge questions, and student reinforcement of skills are also present.

Student Edition

The basic organizational structure of the Student Edition is the unit. There are nine units that are broken down into topic chapters containing three to five content specific sections. The unit themes covered in CPO Integrated Physics and Chemistry were chosen because of their relevance to the TEKS and CPO's commitment to in-depth coverage of science concepts. The glossary and index have been designed so students can quickly skim for page numbers and definitions. Each student section contains pertinent content and skills-development reading with numerous illustrations for reading support. Each chapter contains an extensive review question section that evaluates the student's progress in areas such as: vocabulary development, concept understanding, computation skills, and application. Special features of the Student Edition:

- **Chapter pages:** These introductory pages present the major components of the student reading, including Investigation descriptions, what the student will learn from the section, and the pertinent vocabulary.
- **Side heading outlines:** Developing literacy skills in math and reading is stressed throughout the instruction. Left-margin side headings highlight the main ideas in the text and help the student grasp reading concepts through skimming, scanning, and key word identification.
- **Highlighted vocabulary:** Science vocabulary mastery is paramount for science concept understanding. Science vocabulary can be highly technical and abundant. Vocabulary words are highlighted for easy identification and defined in a variety of ways.
- **Numerous visual teaching tools:** The Student Edition contains graphics, charts, illustrations, and data tables supporting abstract conceptual learning. These teaching tools reinforce instruction and aid in visual representation of material necessary for addressing multiple learning styles. The visuals are precise in content and presentation and reflect CPO's commitment to accuracy, science content excellence, and inquiry-based instruction.

Investigations

"The greatest tragedy of Science: the slaying of a beautiful hypothesis by an ugly fact."

Thomas Huxley

The Investigations are the heart of the CPO Science Program. We believe that most students learn best and are motivated to learn through direct experience and exploration activities. Key questions focus the student on the main point of the learning and what they should be able to answer after the experiment. There is at least one Investigation for each student reading section. The student reading and Investigation closely compliment the science instruction and reinforce the same principles.

Each Investigation is introduced with a key question that the students will be able to answer after completing the hands-on activity. Students are also given learning goals for each Investigation and a short informational piece to get them thinking about the content of the Investigation. Student answer pages are found in the teacher's blackline master notebook. The teacher can duplicate the forms for students to complete and answer the questions.

Each Investigation begins with a key question and uses leading questions to aid in skill development, reflection, and application. An observation form is found in the *Strategies and Tables* section of the reference volume to aid the teacher in evaluating Investigations as performance-based tasks.

Investigations are usually completed before the accompanying student reading section. The CPO philosophy is based on the premise that through discovery, the students will begin to understand foundation skills and concepts. The student readings strengthen the students' knowledge of theory and aid in their understanding. For certain Investigations, the student reading must be read first so that students have the basic knowledge necessary to complete the Investigation. Whether a section should be read before or after an Investigation is explained under the reading synopsis heading in the teacher's guide pages for each section.

Special Features

- **Data collection, graphing skills and the scientific process:** These skills are emphasized and reinforced throughout the program and students are frequently encouraged to practice these skills as self-learners.
- **Lesson planning page:** The information you need to know to teach and conduct the Investigation is available in the teacher's guide section pages. The learning goals and questions, equipment setup requirements, consumable materials list, teaching sequence, and a synopsis of the student reading are all in found on the lesson introduction pages.
- **Icons:** Throughout the Investigations, icons are used to point out safety requirements and to reference important information for the students. A reference sheet of the icons and the meaning of each is found in the Student Edition and the teacher's guides.
- **Equipment:** Specialized equipment has been designed to accompany the teaching of the Investigations. The equipment is durable and provides consistent accurate results.

Teacher's guides

"The most important thing in science is not so much to obtain new facts as to discover new ways to think about them."

William Bragg

The teacher's guides are constructed around the same premise as the student instructional materials: inquiry-based learning. The guides include a sample demonstration lesson for each Investigation written as a dialogue between the teacher and the class. These samples demonstrate how to teach the Investigation using inquiry-based teaching and student group discovery. The sample demonstration is only one example of teaching the Investigation with possible student responses. Teaching tips, the accompanying student section synopsis, projects, and teaching strategies are also included.

The first two pages of each teacher's guide section contain a clear, concise overview of the Investigation. It is our belief that a quick guide is useful in outlining the learning objectives, setting up the Investigation, and mapping the sequence of the Investigation procedures. These pages contain a brief synopsis of the student reading, review of the leading question, learning objectives, and a clear equipment and consumable materials list. The equipment setup instructions are identified with an equipment icon and are found in this volume under the *Equipment Setup* section.

The Investigation lesson pages present a sample teaching scenario written as a dialogue between the teacher and class. The dialogues present actual lessons taught from the teacher's point of view, as well as possible student responses. The dialogues provide excellent support for teachers who are new to the subject area, as they identify possible student misconceptions and highlight important learning content. The dialogues provide teaching tips such as:

- What to put on the chalkboard.
- How to teach by questioning.
- What reactions the students may have and how to respond.
- Interesting stories to make connections between key concepts and everyday life.
- Computational information.

Organization of the teacher's guides

The teacher's guides are divided into five unit volumes and the reference volume. The volumes have been divided according to similar objectives, content coverage, and specific equipment needs. The lightweight topic volumes are easy to carry and content is focused on one to three units. You will only need one volume and the reference section when planning a lesson. The teacher's guides contain the Student Edition text and all the information you need to teach and evaluate each unit. The reference volume includes: assessment questions and answers, quick reference charts, teaching information, the glossary and index. The unit contents for the teacher's guides are:

Volume 1: Reference Guide
Volume 2: Force and Motion, Work and Energy
Volume 3: Electricity and Magnetism
Volume 4: Sound and Waves, Light and Optics
Volume 5: Properties of Matter, Changes in Matter, Water and Solutions
Volume 6: Heating and Cooling

Equipment

CPO products are high-quality, accurate, and long-lasting. These characteristics are found in all the equipment used to teach the concepts in the CPO Science Program. Equipment has been especially designed and tailored to the course goals and tested to ensure precise data and repeatable findings.

You can use the CPO Science Program to its fullest potential by taking advantage of all the benefits of using hands-on equipment. There is a section in this book that presents all the equipment and how to set up and use each piece. Information is presented in the Investigations that also explains how to set up the equipment and how it will be used throughout the experiments.

"The strongest arguments prove nothing so long as the conclusions are not verified by experience. Experimental science is the queen of sciences and the goal of all speculation."

Roger Bacon

The table below outlines the equipment pieces and units where the equipment is needed.

Equipment Name	Units Equipment is Needed	Concepts
Car and ramp	Unit 1, 2	motion, speed, acceleration, Newton's laws
Rollercoaster	Unit 2	energy conservation, transformation, potential and kinetic energy
Gears and levers	Unit 2	simple machines, input and output force, mechanical advantage
Ropes and pulleys	Unit 2	simple machines, work, energy
Electric circuits and motor	Unit 3	voltage, current, resistance, series circuits, parallel circuits
Pendulum	Unit 4	harmonic motion, time, frequency, period, cycle, amplitude
Sound and waves	Unit 4	sound, music, frequency, period, wavelength
Spectrometer	Unit 4	wavelength, light, color
Light and optics	Unit 5	light, color, optics, reflection, refraction, lasers
Periodic table tiles	Unit 6,7	the periodic table, chemical formulas, balancing chemical equations
Displacement tank	Unit 6	buoyancy, force, weight, mass, displacement
Atom Building Game II	Unit 6,7	atomic structure, electrons and bonding, atoms, ions, isotopes

***The Timer and the Physics Stand are used with Force and Motion, Work and Energy, and Sound and Waves.**

The equipment is available in suggested packages depending on the needs of the school or district. Districts will receive an equipment voucher that can be used to receive the appropriate equipment package to fit teaching needs. The equipment quantity included in the voucher will depend upon the number of textbooks a district purchases for its students from the adoption process.

Sharing Equipment

Many schools share lab equipment among science teachers. The CPO Science Program has been designed to meet this need with alternative sequences for teaching the units. The sequences outlined in the chart below allow three teachers to simultaneously teach different units of the program and share one classroom set of equipment. If the time for each rotation is followed, there is no overlap for any piece of equipment used in the program.

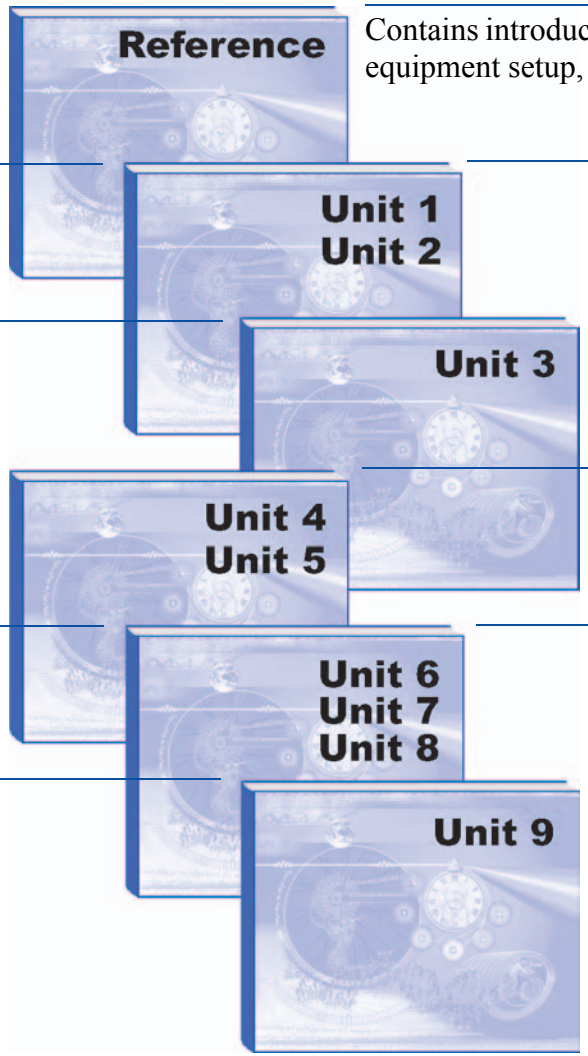
Each teaching sequence allows for a suggested teaching time period and a week for review and evaluation. The teacher's guides have been divided into volumes so that every teacher in the rotation can use the volume they need for the units they are teaching.

Other equipment rotation suggestions include: creating a designated space as a science lab with multiple sets of equipment, and portable equipment science labs that can be moved from classroom to classroom.

Suggested Teaching Sequence and Rotation of Equipment for Three Teachers

Teacher One	Unit 1: Forces and Motion Unit 2: Work and Energy	Unit 3: Electricity	Unit 9: Heating and Cooling	Unit 4: Sound and Waves Unit 5: Light and Optics	Unit 6: Properties of Matter Unit 7: Changes in Matter Unit 8: Water and Solutions
	8 teaching weeks *1wk review/evaluation*	*4 teaching weeks* *1wk review/evaluation*	*4 teaching weeks* *1wk review/evaluation*	*4 teaching weeks* *1wk review/evaluation*	*10 teaching weeks* *1wk review/evaluation*
Teacher Two	Unit 3: Electricity	Unit 4: Sound and Waves Unit 5: Light and Optics	Unit 6: Properties of Matter Unit 7: Changes in Matter Unit 8: Water and Solutions	Unit 1: Forces and Motion Unit 2: Work and Energy	Unit 9: Heating and Cooling
	4 teaching wks *1wk review/evaluation*	*4 teaching wks* *1wk review/evaluation*	*10 teaching weeks* *1wk review/evaluation*	*8 teaching wks* *1wk review/evaluation*	*4 teaching weeks* *1wk review/evaluation*
Teacher Three	Unit 6: Properties of Matter Unit 7: Changes in Matter Unit 8: Water and Solutions	Unit 1: Forces and Motion Unit 2: Work and Energy	Unit 9: Heating and Cooling	Unit 3: Electricity	Unit 4: Sound and Waves Unit 5: Light and Optics
	10 teaching weeks *1wk review/evaluation*	*8 teaching weeks* *1wk review/evaluation*	*4 teaching weeks* *1wk review/evaluation*	*4 teaching weeks* *1wk review/evaluation*	*4 teaching weeks* *1wk review/evaluation*

How the Volumes Are Organized



Volume 1

Contains introduction, scope and sequence, answer keys to review questions, teaching tools, equipment setup, and the glossary and index from the Student Edition.

Volume 2

Forces and Motion / Work and Energy
Teacher's guides (white pages) and Student Edition (cream color pages)

Volume 3

Electricity and Magnetism
Teacher's guide (white pages) and Student Edition (cream color pages)

Volume 4

Sound and Waves / Light and Optics
Teacher's guides (white pages) and Student Edition (cream color pages)

Volume 5

Properties of Matter / Changes in Matter / Water and Solutions
Teacher's guides (white pages) and Student Edition (cream color pages)

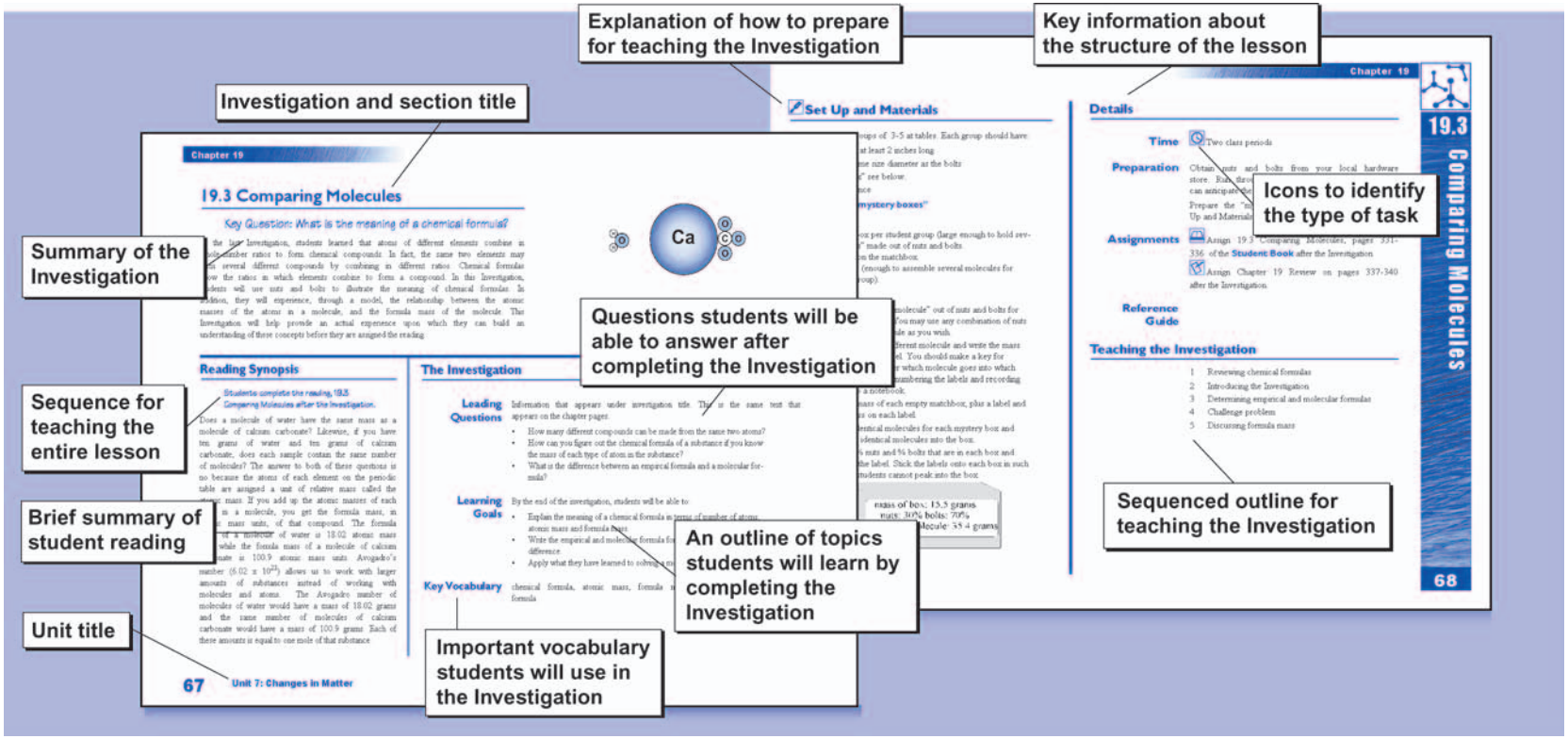
Volume 6

Heating and Cooling
Teacher's guide (white pages) and Student Edition (cream color pages)

The Teacher's Guide Investigation Overview Pages

The teacher's guide for each Investigation begins with the overview pages. The overview pages correspond to each section of the Student Edition and each Investigation in the CPO Science Program. These pages review the instructional components, beginning with a summary of what the students will learn in the Investigation. Included are a synopsis of the reading, pertinent vocabulary from the Investigation, learning goals, and the key and leading questions that students will be able to answer after completing the Investigation. It is important to note that below the heading for the reading synopsis, there is a suggested sequence for teaching the student section and the Investigation. The student reading section frequently follows the completion of the hands-on Investigation. In some sections, the student reading must be completed first in order for students to assimilate the skills and concepts required to complete the Investigations.

The second page outlines the equipment and material needed, teacher's guide section considerations, and the sequence of teaching steps.



Teacher's Guide Demonstration Lessons

Each teacher's guide demonstration lesson contains an outline of the lesson, a "sample dialogue," and teaching strategies and tips. These pages also include the Investigation and sample answers to the activity. In the facing-page format, you can review the sample dialogue between the teacher and students, the Investigation page, and sample data and answers. All the information you will need to teach the Investigation is easily skimmed in this format.

Below are the features of the dialogue, Investigation answer page, and sidebar teacher notes.

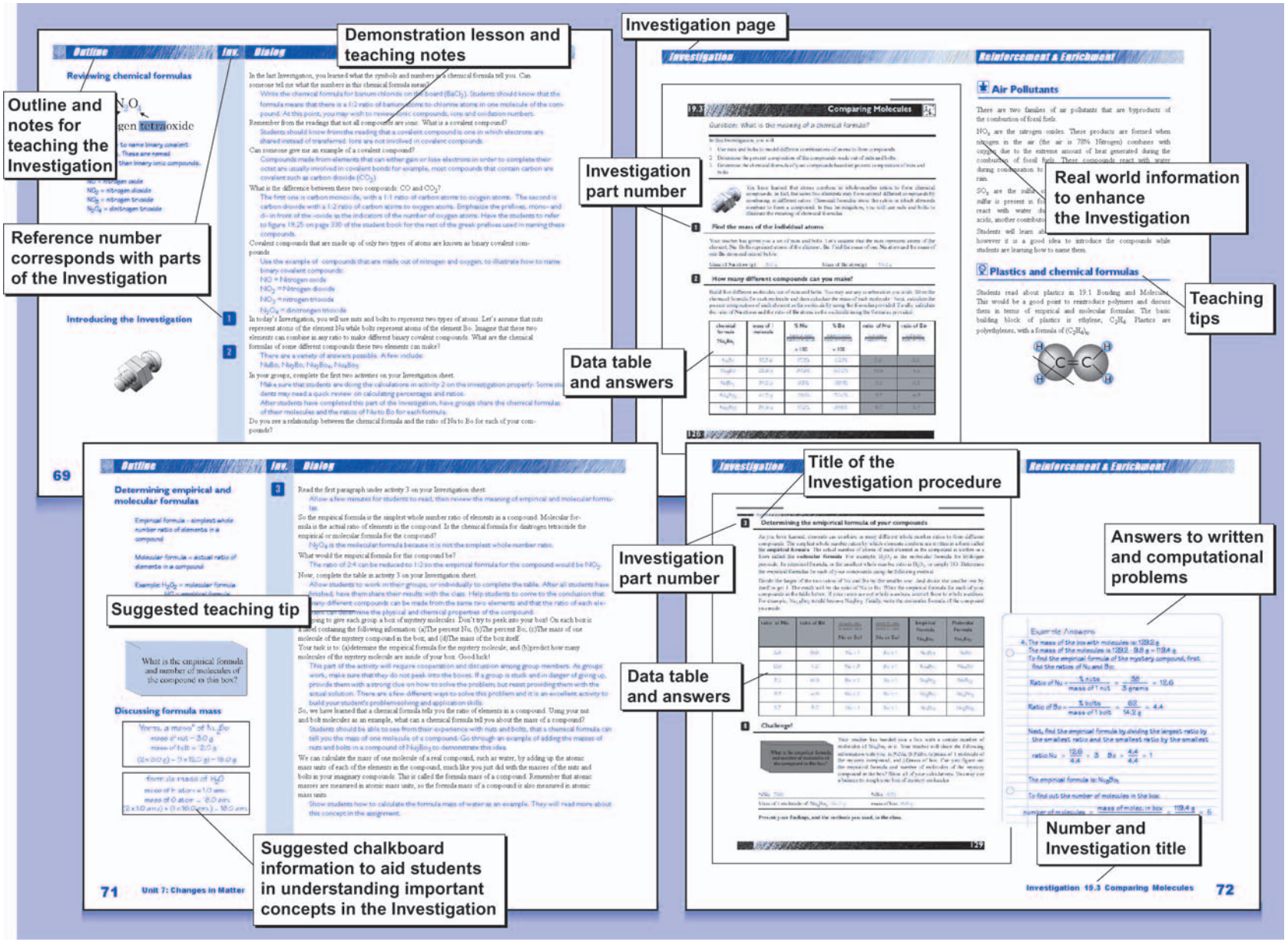
Outline: This section contains an at-a-glance sequence of steps that a teacher can skim. It is a quick guide to what is taught in the Investigation and notes on the Investigation.

Inv.: In this column the teacher will find a reference number that matches the parts of the Investigation page. These corresponding numbers guide you to the part that is discussed in the dialogue.

Dialogue: This section is presented as an exchange between the teacher and the class. This sample lesson outlines what the teacher would actually say to the class and typical responses from the students. Helpful teaching ideas and tips such as: "Students will need access to water," "Group supervision is important at this point" are included. The teacher's directions and comments to the students are printed in black, and responses and directions are in blue text. It is our hope that teachers will review the dialogue before presenting the Investigations to the class, as a supportive tool and to help clarify the goals and important points of each Investigation.

Investigation: This is a miniaturized Investigation page that is referenced in the dialogue. The Investigation page includes answers to data tables and written responses. The teacher can refer to the numbers at the left of the Investigation page and match them to the opposite page as numbers under the column "Inv." These numbers indicate what section of the Investigation the dialogue is referring to. The data and some of the reflective answers are only examples of data and responses that can be given by the students.

Reinforcement and Enrichment: This section includes teaching tips, challenge questions, and more reinforcement ideas for students who may need extra time learning concepts. Ideas for future study and short interesting pieces are also found in this right-hand margin area.


Demonstration lesson and teaching notes
Investigation page
Outline and notes for teaching the Investigation
Investigation part number
Real world information to enhance the Investigation
Reference number corresponds with parts of the Investigation
Data table and answers
Teaching tips
Title of the Investigation procedure
Suggested teaching tip
Investigation part number
Answers to written and computational problems
Data table and answers
Suggested chalkboard information to aid students in understanding important concepts in the Investigation
Number and Investigation title

Safety

Safety is highlighted throughout the CPO Science Program by the use of safety icons and safety tips in the Investigations. The Investigations activities and experiments have been written to reduce safety concerns in the laboratory. The equipment that is used for physics is very stable and easy to use and manage. All the chemistry Investigations use supplies and chemicals that can be purchased readily in a grocery or hardware store. Although this does not mean that these supplies are non-toxic, you will be able to dispose easily of most of these chemicals. In cases where you are concerned about safety and proper use or disposal, we strongly recommend that you obtain the Materials Safety Data Sheets (MSDS) for the chemicals. These are easily obtained by calling the manufacturer of the product.

The CPO Science Program introduces students to safety through an information Safety Skill Sheet. In addition to this sheet, we have provided a quiz as an evaluation tool to be administered to the students after you have covered safety in the laboratory. We recommend devoting an entire lesson to safety in the classroom and laboratory and responsibilities for maintaining a safe environment. Use the Safety Skill Sheet as a guide for your lesson and fill in any information and guidelines that are particular to your classroom and school. In the skill sheet section of this book you will find a student safety contact. Safety is such a crucial concern when working in a laboratory environment that having students sign a contract may emphasize that safety in the science lab is everyone's responsibility.

Units and Measurement

The CPO Science Program was designed to prepare students to be successful in any career, not just academia. Students need to be fluent with scientific skills in any system of units prevalent in the workplace. Virtually all engineering and industrial careers require proficiency in both English and metric units. Even metric measures are not standardized. Research scientists use two varieties of metric: meter-kilogram-second (MKS) for physics and centimeter-gram-second (CGS) for chemistry. Ocean and air transportation industries use nautical miles. Medicine uses both Fahrenheit and Celsius temperature scales. Astronomers use light-years. The message to take from this diversity is that students need to learn and practice science in several systems of units because they will encounter different systems outside the classroom.

You will find that the text, examples, and questions gradually transition from mixed English/metric to all metric by the end of Unit 2. Because of their extensive practical use, the Student Edition and Investigations include both English and metric (MKS) units in Unit 1 (Force and Motion). This was done to connect the student's common experience and also to provide a bridge between the systems. For subsequent units, almost all concepts are presented in metric units, with an occasional reference to other systems when appropriate. All of the assessments use only metric units, which is common practice for standardized tests. The chemistry units (6-8) switch from MKS to CGS to mirror research, medical, and industrial chemistry, which is measured predominantly in grams and milliliters instead of kilograms and cubic meters. It is our opinion that a basic high school science education should be focused on developing practical quantitative reasoning, problem solving, and observational skills. By presenting a mixture of units as they occur in the real world, we help prepare students for success in any endeavor that requires scientific thinking, such as business, industry, or education, as well as for further study in science.