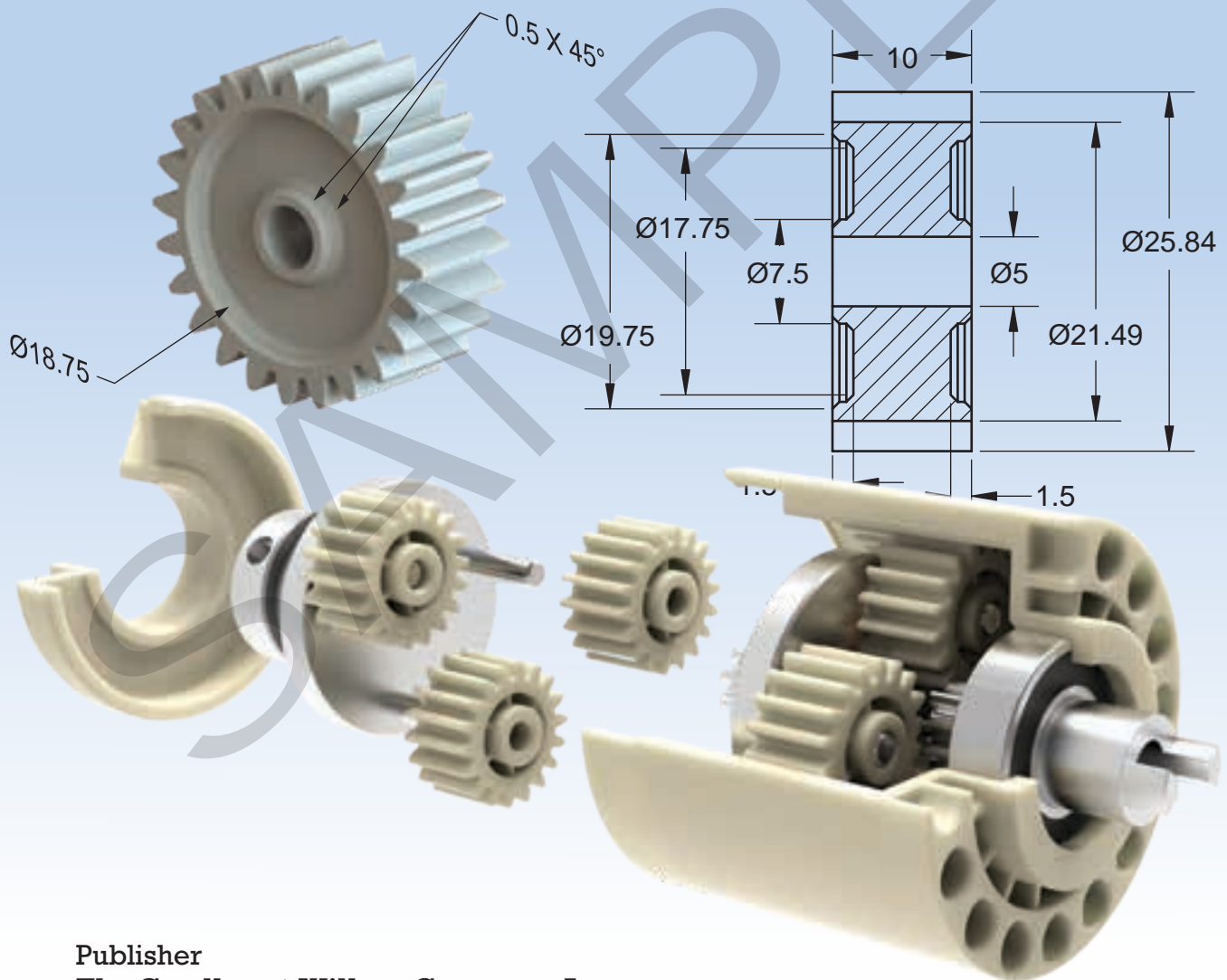


Exploring Drafting

13TH EDITION

John R. Walker | Bernard D. Mathis | Shauna Ann Scribner



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Preface

A course in drafting should be a part of your education. It will help you develop the capacity to plan and solve problems in an organized fashion, to interpret the ideas of others, and to express yourself in a manner that can be easily understood by anyone.

Exploring Drafting provides information about drafting fundamentals and concepts. It also provides opportunities to learn about basic geometric constructions. These are the mathematical tools used to solve practical problems and create the various types of drawings that communicate information about products. As you read and work through the book, you will learn the drafting methods and processes used by industry. You will also develop and practice drafting skills and techniques.

Exploring Drafting covers practices established in standards published by the American Society of Mechanical Engineers (ASME). You will learn how to use standard symbols to communicate in the international language—drafting.

Exploring Drafting provides you with the basic understanding necessary to allow you to progress from manual drafting into CAD (computer-aided drafting and design). The information and activities in this text will supply you with the solid foundation of drafting skills and techniques you will need to efficiently draw and design using most CAD systems. It is important to note that CAD is a tool that incorporates the concepts of manual drafting. The principles of drafting are common to both traditional (manual) drafting and CAD.

Exploring Drafting provides information and activities that are consistent with and satisfy the basic drafting standards that have been adopted by many states and/or school districts. The content and activities in the book also are consistent with the International Technology and Engineering Educators Association (ITEEA) Standards for Technological and Engineering Literacy.

Drafting, the “language of industry,” offers many career opportunities. Some of these exciting and rewarding career paths are described in Chapter 2, *Careers in Drafting*.

You will find that the ability to draw and to understand drafting will be of benefit throughout your lifetime as a consumer, as well as in the career you pursue. The ability to draft and understand drawings is an ability that most anyone will find useful.

About the Authors

During his career, John R. Walker authored 13 textbooks and wrote many magazine articles. Mr. Walker taught industrial arts and vocational education for 32 years and was Supervisor of Industrial Education for five years. Mr. Walker also worked as a machinist for the US Air Force and as a drafter at the US Army Aberdeen Proving Grounds.

Bernard D. “Bernie” Mathis has bachelor’s and master’s degrees in Industrial Arts Education from the University of Northern Colorado. He taught industrial arts and industrial technology for 40 years. During his teaching career, Mr. Mathis taught mechanical engineering drawing and architectural engineering drawing for 35 years and computer-aided drafting for 28 years. Prior to teaching drafting classes, Mr. Mathis taught other industrial arts courses, including woodworking, metalworking, general crafts, leather crafts, lapidary, and jewelry. Mr. Mathis was also sole proprietor of his own drafting and design business for 30 years. Now retired, Mr. Mathis does freelance architectural drafting and design for RL Design.

Shauna A. Scribner has two associate’s of applied science degrees in Design Drafting and Metals Technology from Central New Mexico Community College, a bachelor’s degree in Training and Technology from the University of New Mexico, and a master’s degree and doctorate in Workforce Education and Development from Southern Illinois University-Carbondale. She has taught computer-aided drafting and design, engineering graphics, and manufacturing technology for more than 20 years. Prior to working as a CAD facilitator, Dr. Scribner worked in the public sector as a lead drafter/designer and was the owner and operator of her own CAD company for 22 years. For the past 20 years, Dr. Scribner has worked as a professor and CAD program coordinator at Southwestern Illinois College.

Reviewers

The authors and publisher wish to extend special thanks to Walter Cheever for his efforts in reviewing the text and coordinating the use of architectural drawings from KMA Design & Construction.

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New to This Edition

This edition of *Exploring Drafting* includes new illustrations and expanded coverage of topics throughout the text. The following is a summary of changes and new features in this edition.

- New photographic and drawing-based illustrations highlighting drafting practices and industry applications have been added.
- Chapter 9, *Multiview Drawings*, introduces the types of projection used to project object views on technical drawings.
- Coverage on geometric dimensioning and tolerancing (GD&T) has been updated in Chapter 10, *Dimensioning*, to reflect changes in the ASME Y14.5 standard.
- Chapter 13, *Pictorials*, features expanded coverage on axonometric projection methods. Coverage focuses on the principles of isometric projection and the differences among isometric projection, dimetric projection, and trimetric projection. Chapter 13 also includes new coverage on Boolean modeling operations. In addition, a new set of isometric drawing problems has been added in the chapter review section. The new problems are spatial visualization exercises based on coded plans.
- Chapter 15 includes new coverage on detail views.
- The Reference Section includes a new *Math Review* section covering basic mathematics principles and formulas.

Using This Textbook

A number of elements in this text help reinforce the material as it is presented. You will encounter the following features as you progress through the text. They are intended to guide you through the material and help you evaluate your progress.

ADDA Approved Publication



The content of this textbook is considered a fundamental component to the design drafting profession by the American Design Drafting Association (ADDA). This publication covers topics and related material as stated in the ADDA Curriculum Certification Standards and the ADDA Professional Certification Examination Review Guides. Although this publication is not conclusive, with respect to ADDA standards, it should be considered a key reference tool in pursuit of a professional career. For more information about the ADDA certification exams and becoming a certified drafter, visit the ADDA website.

Color Code

A color coding system is used throughout the text to identify different linetypes in drawings. For example, dimension lines and extension lines are printed in red. Chapter 3, *Sketching*, introduces the Alphabet of Lines and the color coding system used to identify lines in drawings throughout this text.

Drawing Problems

Throughout this text, conventional drawings are constructed in a step-by-step fashion to demonstrate drawing principles. In chapters with drawing instruction, the *Drawing Problems* section at the end of the chapter gives you an opportunity to practice your drafting skills and improve your techniques. These problems progress in difficulty from basic to advanced.

Star icons are used to identify each drawing problem as basic, intermediate, or advanced. The different star icons and their meanings are shown below.

Basic



Intermediate



Advanced



More challenging design problems are also provided to help you develop your originality and creativity.

Reference Section

This text includes a reference section with tables and charts containing helpful resources for various types of drafting. Included are illustrations of standard symbols, a listing of common abbreviations, conversion tables, and screw thread data. Also included in this section is a *Math Review* section covering basic principles of mathematics. The information in the reference section expands on material covered in the book.

Glossary

A glossary of terms is included at the end of the textbook. This section provides definitions for all of the terms that appear in the *Drafting Vocabulary* listings.

Certification Standards

Precision Exams by YouScience Certification

Goodheart-Willcox is pleased to partner with YouScience to correlate *Exploring Drafting* with the CAD Mechanical Design I certification standards. Students who pass the exam and performance portion of the exam can earn a Career Skills certification. Precision Exams by YouScience and Career Skills Exams were created in partnership with industry and subject matter experts to align real-world job skills with marketplace demands. Students can showcase their skills and knowledge with industry-recognized certifications—and build outstanding résumés to stand out from the crowd!

And for teachers, Precision Exams by YouScience provides:

- Access to a library of Career Skills Exams, including pre- and post-assessments for all 16 National Career Clusters
- Suite of on-demand reporting to measure program and student academic growth
- Easy-to-use, 100% online administration

To see how *Exploring Drafting* correlates to Precision Exams by YouScience standards, visit the Correlations tab at www.g-w.com/exploring-drafting-2023. For more information about Precision Exams by YouScience, visit www.youscience.com/certifications/career-clusters/.



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Features of the Textbook

The instructional design includes student-focused learning tools to help students succeed. This visual guide highlights the features designed for the textbook.

Objectives clearly identify the knowledge and skills to be obtained when the chapter is completed.

Before You Begin activities provide suggestions to help guide you in reading the chapter.



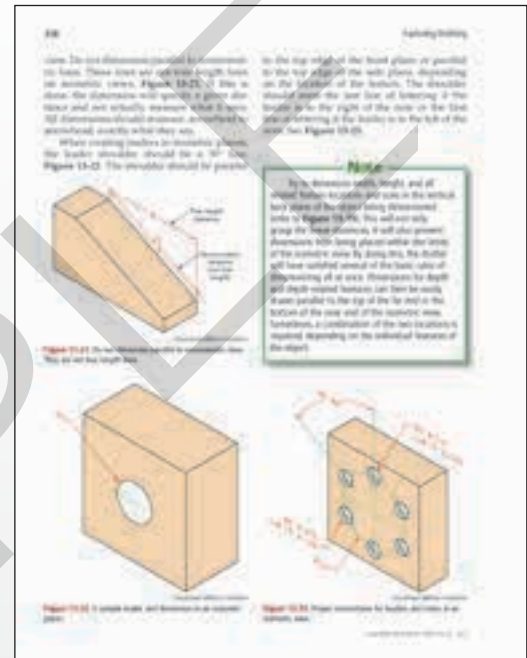
Drafting Vocabulary lists the key terms to be learned in the chapter. Review this list after completing the chapter to be sure you know the definition of each term.

Employability features at the beginning of each chapter address the knowledge, skills, and attitudes necessary to succeed in the modern work environment.

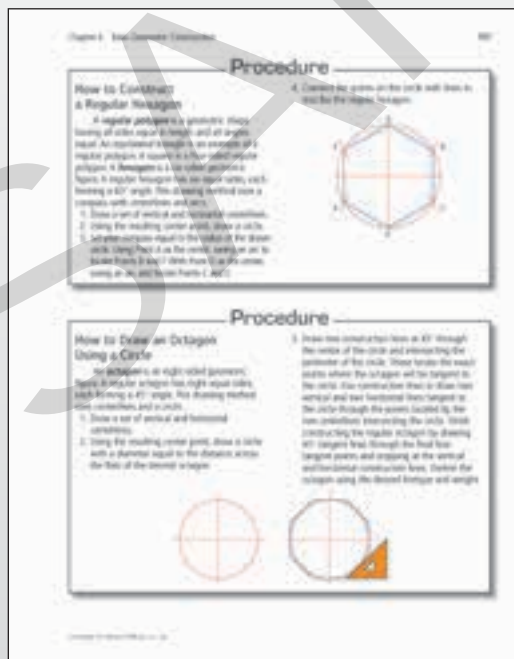


Safety Notes alert you to potentially dangerous materials and practices.

Notes clarify explanations in the text and provide more detailed information about related topics.



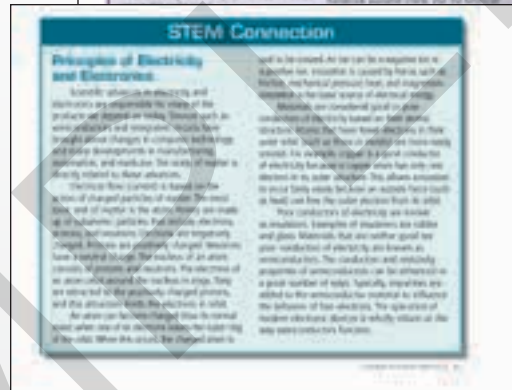
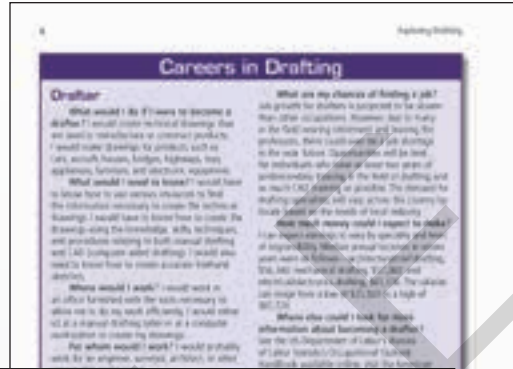
Illustrations have been designed to clearly and simply communicate the specific topic. Photographic images have been updated to show the latest equipment.



Procedures throughout the textbook provide clear instructions for hands-on drafting activities. You can refer back to these procedures when needed.

Careers in Drafting features explain the types of careers available in the related drafting discipline. These features provide information about the many career opportunities available in industry.

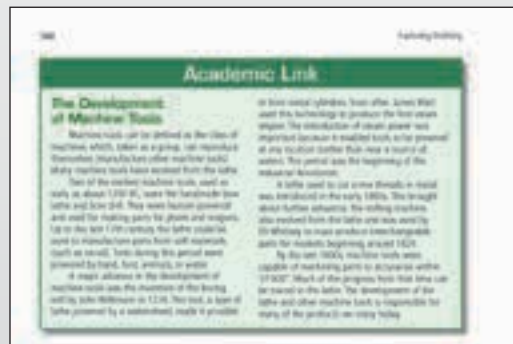
CAD Application features provide an introduction to the methods and processes used in computer-aided design and drafting. Each CAD Application feature addresses topics pertaining to the related chapter.



STEM Connection cross-curricular features relate the major topics of a chapter to the science, technology, engineering, and mathematics (STEM) education paths. Often, you will find that the skills and knowledge learned in the study of drafting are relevant to these education paths.

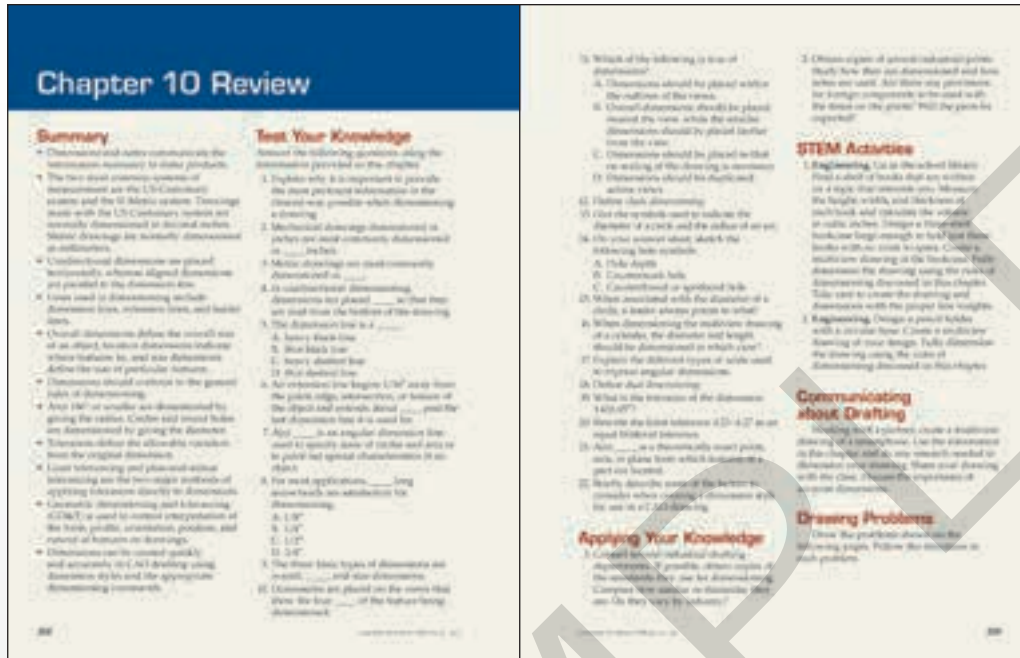


Industry Connection features focus on modern business practices and trends. Each Industry Connection feature provides an inside look into current and future technologies in drafting and related industries.



Academic Link features provide references to different areas of study. Each Academic Link feature discusses topics pertaining to the related chapter.

Summary feature provides an additional review tool for you and reinforces key learning objectives.



Applying Your Knowledge activities are designed for individual or group participation and help you apply the material and build drafting skills.

STEM Activities support preparation for careers related to the science, technology, engineering, and mathematics (STEM) education paths and provide opportunities to demonstrate skills.

Communicating about Drafting activities provide opportunities to build speaking, listening, and language arts skills associated with topics covered in the chapter.

Test Your Knowledge questions allow you to demonstrate knowledge and comprehension of chapter material.

Drawing Problems provide opportunities to apply drafting and problem-solving skills. The drawing problems progress in difficulty from basic to advanced.

TOOLS FOR STUDENT AND INSTRUCTOR SUCCESS

Student Tools

Student Text

Exploring Drafting teaches fundamental drafting skills and practices. Designed for use in introductory courses, this text teaches both manual and CAD drafting skills and is appropriate for beginning drafting students at any instructional level. Topics covered include sketching, basic geometric constructions, orthographic projection, and dimensioning practices. This text teaches techniques and procedures used in creating multiview drawings, sectional views, auxiliary views, pictorial views, and pattern developments. The end-of-chapter drawing problems provide opportunities for students to practice drafting techniques and apply problem-solving skills. This text teaches methods and processes used in industry and adheres to standard ASME practices.



Worksheets

The student Worksheets supplement provides hands-on drafting activities designed to enrich and reinforce the content from the textbook. The worksheets are intended to help students develop problem-solving skills and eliminate repetitive drawing. Problems selected from the text are presented in order of increasing difficulty.

Online Learning Suite

The Online Learning Suite provides the foundation of instruction and learning for digital and blended classrooms. An easy-to-manage shared classroom subscription makes it a hassle-free solution for both students and instructors. An online student text and printable worksheets, along with rich supplemental content, brings digital learning to the classroom. All instructional materials are found on a convenient online bookshelf and are accessible at home, at school, or on the go.



Online Learning Suite/Student Text Bundle

Looking for a blended solution? Goodheart-Willcox offers the Online Learning Suite bundled with the printed text in one easy-to-access package. Students have the flexibility to use the printed text, the Online Learning Suite, or a combination of both components to meet their individual learning styles. The convenient packaging makes managing and accessing content easy and efficient.

Instructor Tools

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To provide a complete learning package for you and your students, G-W Common Cartridge includes all content from the Online Learning Suite and Online Instructor Resources. When you incorporate G-W content into your courses via Common Cartridge, you have the flexibility to customize and structure the content to meet the educational needs of your students. You may also choose to add your own content to the course.

QTI® question banks are available within the Online Instructor Resources for import into your LMS. These prebuilt assessments help you measure student knowledge and track results in your LMS gradebook. Questions and tests can be customized to meet your assessment needs.

Online Instructor Resources (OIR)

Online Instructor Resources provide all the support needed to make preparation and classroom instruction easier than ever. Available in one accessible location, the OIR includes Instructor Resources, Instructor's Presentations for PowerPoint®, and the ExamView® Assessment Suite. The OIR is available as a subscription and can be accessed at school, at home, or on the go.

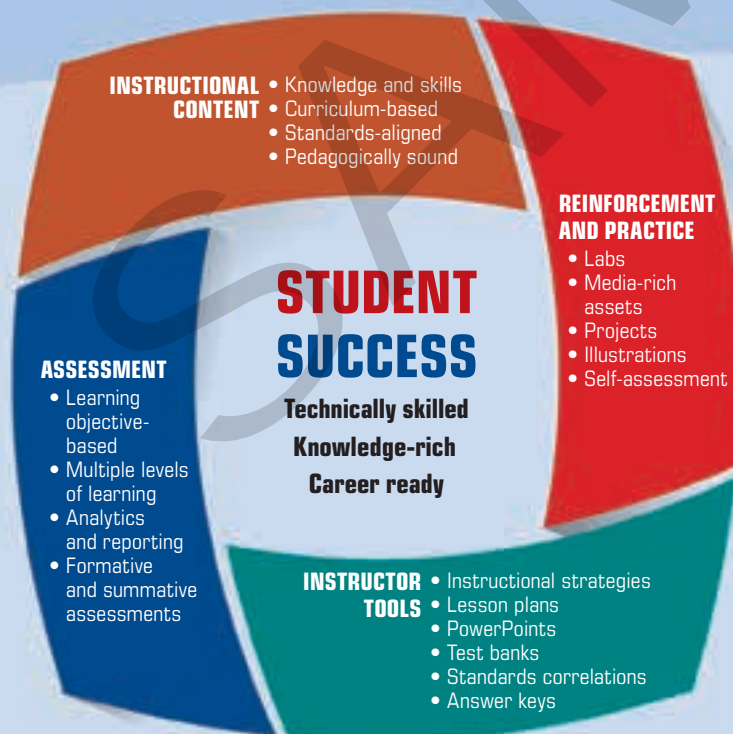
Instructor Resources One resource provides instructors with time-saving preparation tools such as answer keys, editable lesson plans, and other teaching aids.

Instructor's Presentations for PowerPoint® These fully customizable, richly illustrated slides help you teach and visually reinforce the key concepts from each chapter.

ExamView® Assessment Suite Administer and manage assessments to meet your classroom needs. The ExamView® Assessment Suite allows you to quickly and easily create, administer, and score paper and online tests. Included in the assessment suite are the ExamView® Test Generator, ExamView® Test Manager, and ExamView® Test Player. G-W test banks are installed simultaneously with the software. Using ExamView simplifies the process of creating, managing, administering, and grading tests. You can have the software generate a test for you with randomly selected questions. You may also choose specific questions from the question banks and, if you wish, add your own questions to create customized tests to meet your classroom needs.



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ADD A ALERTS
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American Design Drafting Association

President's Message

ADDA's Mission...

"A PROFESSIONAL VISION FOR A NEW GENERATION."

During these times, consider becoming or staying a member of ADDA. This organization recognizes your education and training to become the professional you are. Membership in ADDA also shows that you support your profession and ADDA Membership also helps those who are striving to enter our career field. The cost is affordable and many companies will reimburse or pay for membership. **JANNA**, Email Donna at donna@adda.org for more information.

We are also changing the way we offer testing to schools and professionals. If you would like to become a certified professional at any level it is easier than ever before. We are offering our examinations in single modules. Download the review guide and review the information. You can then choose a single section or multiple sections and take that part of the examination. When you are ready you can choose an additional section or sections. Once you have completed all the sections you will be certified. If you are unsuccessful on any section, that section can be retaken. We feel this will benefit professionals and students alike. Students will be able to take the examination in the order the class curriculum is being offered and not have a major examination at the end of the training program. Contact Pernie at pernie@adda.org for more information.


Our Curriculum Certification has also changed. We are now offering the Certification without all the extensive paperwork that was once required. If you would like to certify your school's training program contact Pernie at pernie@adda.org and she will explain the process.

We are now updating the paperwork and forms for these new processes, but most of them can be managed by email and telephone until we get them completed.

We are currently working on a new protocol and process for the Poster and Drafting Contest. Due to the way schools are operating differently across the country it has made it difficult to manage these programs. Due to many schools being online only and companies downsizing and many employees working from home, coordination and review has been difficult to arrange. Our plans are to have a system operable by next school year.

DON'T MISS UP THESE GREAT ADDA BENEFITS FOR THE PROFESSION

Instructors, ADDA is now proud to offer **Instructor Certification** at three levels of certification. Certified Instructor, Professional Instructor and Master Instructor. Each level requires different amounts of experience and education in a specific area of design drafting instruction. Those areas of instruction are Architectural, Mechanical, General and Digital. ADDA believes that this will



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The American Design Drafting Association (ADDA) supports the design profession by offering industry certifications. ADDA membership offers opportunities for growth and advancement for students, instructors, and professionals through a network of drafters, educational institutions, and businesses.