Principles of Technology
Resource Guide

Table of Contents

Principles of Technology

Introductory Information

What Is *Principles of Technology?*

Principles of Technology is a high school course in applied science taken at the eleventh and twelfth grades. It is a two-year curriculum covering fourteen units in applied physics. The units are:

1. Force	6. Power	11. Transducers
2. Work	7. Force Transformers	12. Radiation
3. Rate	8. Momentum	13. Optical Systems
4. Resistance	9. Waves and Vibrations	14. Time Constants
5. Energy	10. Energy Converters	

Seven units are taught in the first year and seven more are taught in the second year. Each unit typically requires twenty-six 50-minute class periods and shows how a technical concept can be analyzed and applied to equipment and devices in mechanical, fluid, electrical and thermal energy systems.

Materials developed and tested for *Principles of Technology* include student texts, videocassettes, demonstrations, math labs, hands-on labs, and tests. A teacher's guide for each unit provides suggested presentation strategies, information about how to perform classroom demonstrations and additional information for problem-solving labs.

***Principles of Technology* was designed to:**

- increase the employability of students going on from high school to work
- emphasize principles rather than specifics of technology and provide an understanding of the mathematics associated with these principles
- increase the appeal of instruction by using an interest holding instructional system incorporating video presentations, demonstrations, hands-on laboratory exercises, special exercises for students requiring additional help in mathematics, recommendations for "teaching paths" for the teacher and "learning paths" for the students, and a teacher's guide that explains how to orchestrate the learning package
- maintain the academic rigor needed to meet the increased requirements for high school graduation in science

How Did *Principles of Technology* Evolve?

Principles of Technology was developed through a cooperative activity of 45 state and provincial education agencies in association with the Agency for Instructional Technology (AIT) and the Center for Occupational Research and Development (CORD). The education agencies provided over $3,000,000 for the creation of *Principles of Technology* and tested the curriculum in approximately two schools per state. Following the test phase, they took a lead role in introducing and implementing broad use of the course within their service areas. There are now 48 states and two provincial education agencies in the consortium.

Principles of Technology is based on a course entitled *Unified Technical Concepts (UTC) in Physics, which* was developed by CORD for postsecondary technical training. The central idea in this course is that a technically valid, unifying approach to physics is beneficial in the study of the basic energy systems: mechanical, fluid, electrical and thermal. This approach is achieved by demonstrating that concepts such as force, work, rate and resistance apply and operate analogously in each of the four energy forms. The UTC course currently is being used successfully in associate degree technician programs. UTC exhibits particular effectiveness in:

- generating student interest
- helping students retain the technical principles
- making course content relevant and applicable to the technician's field of work.

The Principles of Technology curriculum is an adaptation of the UTC curriculum tailored to the needs of high school students. The existence of UTC considerably shortened the development time of this new course.

Why Should *Principles of Technology* Be Taught?

We all live and work in a sophisticated, rapidly changing society that is becoming increasingly dependent upon an understanding of technology. We need this understanding to make informed decisions about governmental policies, equipment selection for the home or office, and the operation and maintenance of complex devices and systems. But most science courses in physics and chemistry are well written for the 25 percent of high school students who plan to pursue academic degrees at universities but do not present the course material in a manner or at a level that can be mastered or used by the majority of high school students. More than 80 percent of today's high school graduates do not complete a course in physics.

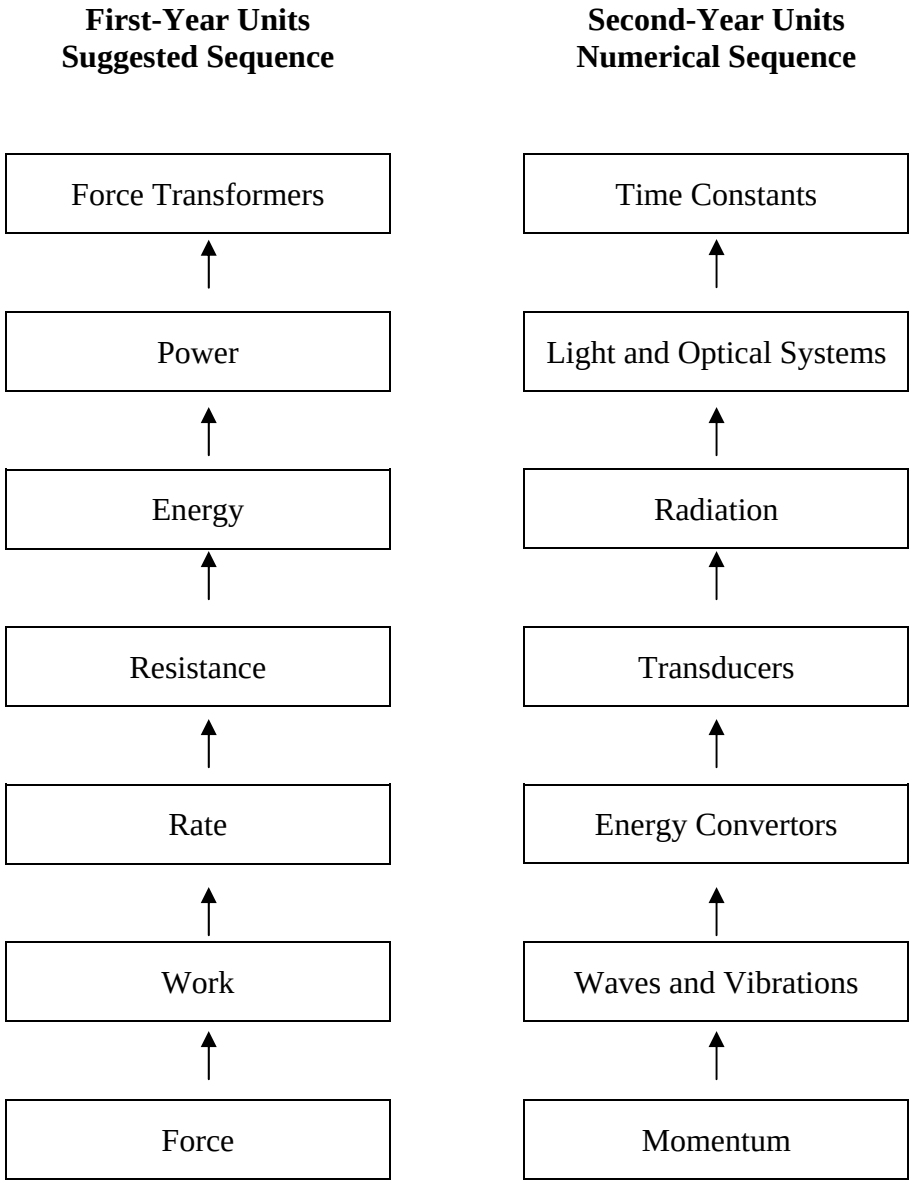
To educate modern technicians we must have a curriculum that not only teaches currently employable skills, but also provides technical principles that will not become obsolete as equipment and technologies change. *Principles of Technology* is designed to be a practical science course for high school students. It does not replace the technical courses that relate to job requirements, and it is not an academically oriented science or mathematics course. It is an applied physics course, oriented toward modern technology.

Principles of Technology is not an easy course. The scientific content and the academic rigor of the course are carefully sustained, both to provide a high quality of instruction and to meet the

goal of filling high school science requirements. Although the course is not easy, pre-testing and post-testing of former students indicate that most achieve significant learning and find the course interesting and useful. *Principles of Technology* is a course that gives students technological literacy.

How Should *Principles of* Technology Be Taught?

The first six or seven units can be used as a stand-alone course for students who need a one-year applied science course and require a background in the technical fundamentals. The second year of the course (Units 8-14) is most useful to students who plan to continue their study and to work as technicians in advanced-technology occupations.



These charts show the suggested sequencing of the units.

Suggested teaching plans indicate that the average unit will require the equivalent of twenty-six 50-minute class periods. These periods are:

- unit overview class and unit summary class, with readings, video presentations, discussions and unit test
- eight class discussions that include reading assignments (four based on subunit video segments and four based on hardware demonstrations)
- four "problem-solving" math labs
- eight hands-on physics labs
- four review periods (repeating the use of the four subunit video segments)

Considerable variation in time required for presentation of a unit has been experienced, first at the field test sites, and more recently at schools that have adopted *Principles* of Technology.

To Whom Should *Principles* of Technology Be Taught?

The target audience specified in the curriculum design is high school students interested in technical careers. The course has been found useful and appropriate for students pursing non-technical careers and students who are in academic pursuits.

The level of the material assumes that students have at least an eighth-grade reading level, have one year of high school general mathematics, and have, if possible, one year of algebra or concurrent enrollment in algebra equivalent courses.

The following types of teachers should teach *Principles of Technology:*

- *Principles of Technology* I and II may be taught with a secondary certificate and a teaching field in technology education (previously industrial technology education, previously industrial arts), physics or science composite. . Technology education teachers must complete 6 semester hours of college physics prior to assignment.

- All teachers assigned to teach *Principles of Technology* shall participate in a Texas Education Agency sponsored workshop for beginning principles of technology teachers prior to teaching the course. The teacher should be given several weeks planning time prior to the beginning of classes, and be given some release time during the first year of instruction to get labs organized and lesson plans prepared

What Is Needed to Put *Principles of Technology* in Place?

Materials: As a member of the *Principles of Technology* consortium you have the right to make unlimited copies of the print and video materials for use at your school. You also may purchase copies of the materials at preferred prices from C. C. I. Publishing and The University of Texas at Austin, Career and Technology Materials.

Facilities: *Principles of Technology* can be taught in a high school science laboratory or a vocational lab supplied with 115-volt AC electrical power, water, drain and compressed air.

It is recommended that six to eight lab stations be provided; however, implementation of the course is possible with two or three lab stations. A VHS videotape player and a television monitor is required.

Equipment: A complete lab equipment list for the *Principles of Technology* labs can be obtained from CORD. Addition information may be obtained from one of the *Principles of Technology* equipment vendors or suppliers. A list of these vendors in supplied with this packet of information.

Does *Principles* of Technology Work in the Classroom?

Ample evidence indicates that *Principles of Technology* works in the classroom. Effects included:

- Learning gains: As indicated by several hundred students pre-posttests, the *Principles of Technology* units resulted in statistically significant learning gains. These gains were consistent among grade levels and sites and between male and female students.
- Positive teacher attitudes: Teachers were also positive about the material. Almost all teachers indicated that they felt comfortable teaching *Principles of Technology.*

These positive findings do not mean that implementing *Principles of Technology* is easy. Certain conditions can enhance the successful implementation of *Principles of Technology.*

- Teacher preparation time: The majority of teachers spend, on average, more than 30 minutes preparing to teach each *Principles of Technology* class. Several reported more than an hour of preparation. This suggests that adequate preparation time should be allowed for a teacher who is initially implementing *Principles of Technology.*
- Teacher background: Teachers with a more extensive physics background tended to be more successful in implementing *Principles of Technology.* Although most students demonstrated a learning gain, those students whose teachers had a more extensive physics background tended to have more pronounced learning gains.
- Class time: Both a comparison of student test scores indicate that 50 to 60 minutes per session is optimum. However, there have been many variations of the 50-minute class period with demonstrated success.
- Lab equipment: The problem that teachers most frequently reported was getting the lab equipment on time. Since the school's ordering system and the vendor delivery process likely will be time-consuming, lab equipment should be ordered well in advance of anticipated use.

Past history shows that *Principles of Technology* does work in the classroom. However, like any educational Innovation, *Principles of Technology* requires hard work. Clearly, a well-coordinated effort among school administrators, counselors, and teachers is the- best way to ensure success.

Principles of Technology

How Do You Begin To Teach *Principles of Technology*?

Principles of Technology is a high school course in applied physics for those who plan to pursue careers as technicians or just keep pace with the advances in modern technology. *Principles of Technology* blends an understanding of basics and principles with practice. Furthermore, *Principles of Technology* builds a firm foundation for understanding technology with today's technology and tomorrow's technology.

In content, *Principles of Technology* is a two-year course that has 14 units. Each unit is devoted to the study of an important concept of technology, such as: force, work, rate, resistance, energy or power. Each unit explains what the principle is and how it's used in mechanical, fluid, electrical and thermal systems. Each unit builds on the knowledge learned in the previous unit. Thus, the 14 units, when taken together, help one understand modern, interdisciplinary systems where mechanical, fluid, electrical and thermal devices often work together, and where many important principles are applied.

What Are The General Course Characteristics?

1. Goals

A. Students will learn the principles of technology and will use the associated mathematics.
B. Students will recognize that technicians must understand basic technical principles, as these principles relate to the world of technology, and how these principles apply to the mechanical, fluid, electrical and thermal energy systems found in technological devices.
C. Students will develop confidence in their ability to understand and apply scientific concepts and principles.

II. Educational Importance of *Principles of Technology*

A. *Principles of Technology* supports and strengthens current mathematics, science and career and technology education programs over a two-year sequence, usually beginning at the tenth grade level and continuing through the twelfth grade.
B. *Principles of Technology* better prepares students for future education in employer based training programs and postsecondary schools.
C. *Principles of Technology* satisfies one or two years of the science requirement for high school graduation in Texas.

111. Target Audience

A. Students

1. Are primarily eleventh-grade or twelfth-grade students interested in technical careers or in depth knowledge of technology and its importance in today’s ever changing

world of work. (The second year of the program is for students who have completed the first year of *Principles of Technology.)*

2. Should have completed one year of high school mathematics.

B. Instructors

1. *Principles of Technology* I and II may be taught with a secondary certificate and a teaching field in technology education (previously industrial technology education, previously industrial arts), physics or science composite.
2. All teachers assigned to teach *Principles of Technology* shall participate in a Texas Education Agency approved workshop for beginning *Principles of Technology* teachers prior to teaching the course. Technology Education teachers must complete 6 semester hours of college physics prior to assignment.

IV. Content

A. Instructional Design

1. Science content consists of

a. Fourteen broad-based physics concepts relevant to the technological workplace. Each concept is organized in a unit of instruction.
b. The technical concepts of Force, Work, Rate, Resistance, Energy, Power and Force Transformers are the first-year units.
c. The technical concepts of Momentum, Waves and Vibrations, Energy Converters, Transducers, Radiation, Light and Optical Systems and Time Constants are second-year instructional units.

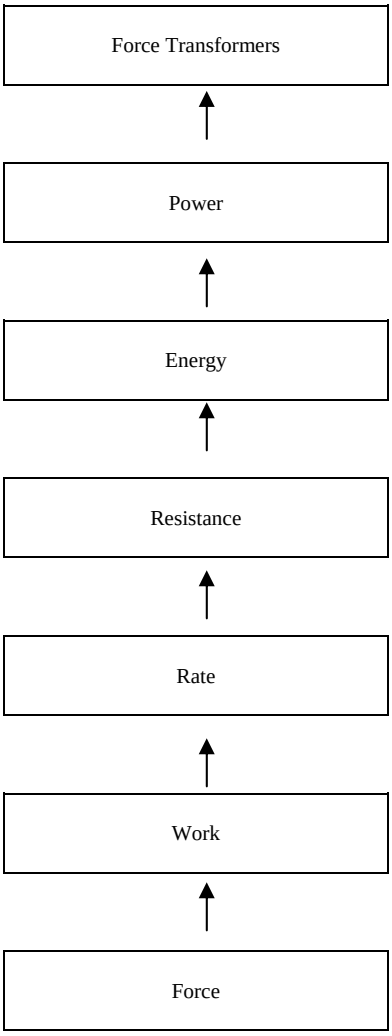
2. The sequence of instruction is

a. First seven units must be taught in order
b. Second seven units may also be taught in numbered order or in the optional paths shown in the figure below.

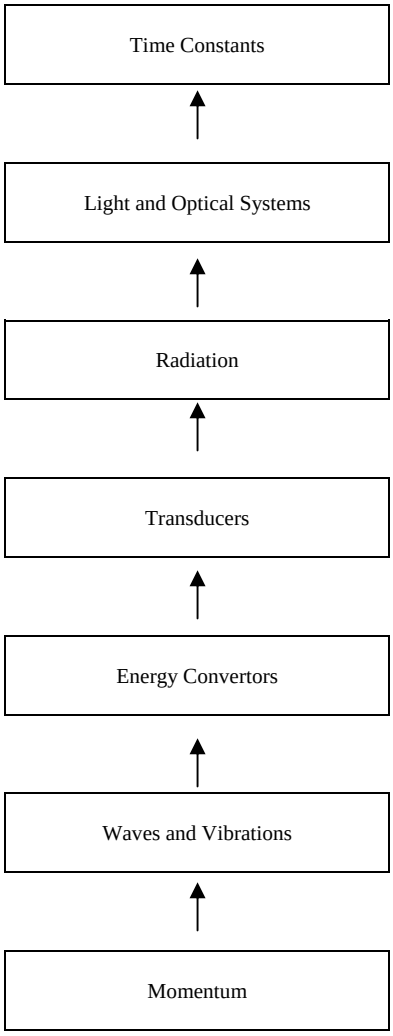
3. Mathematics Content

a. Is determined by the physics content.
b. Both SI and English units of measure are used.

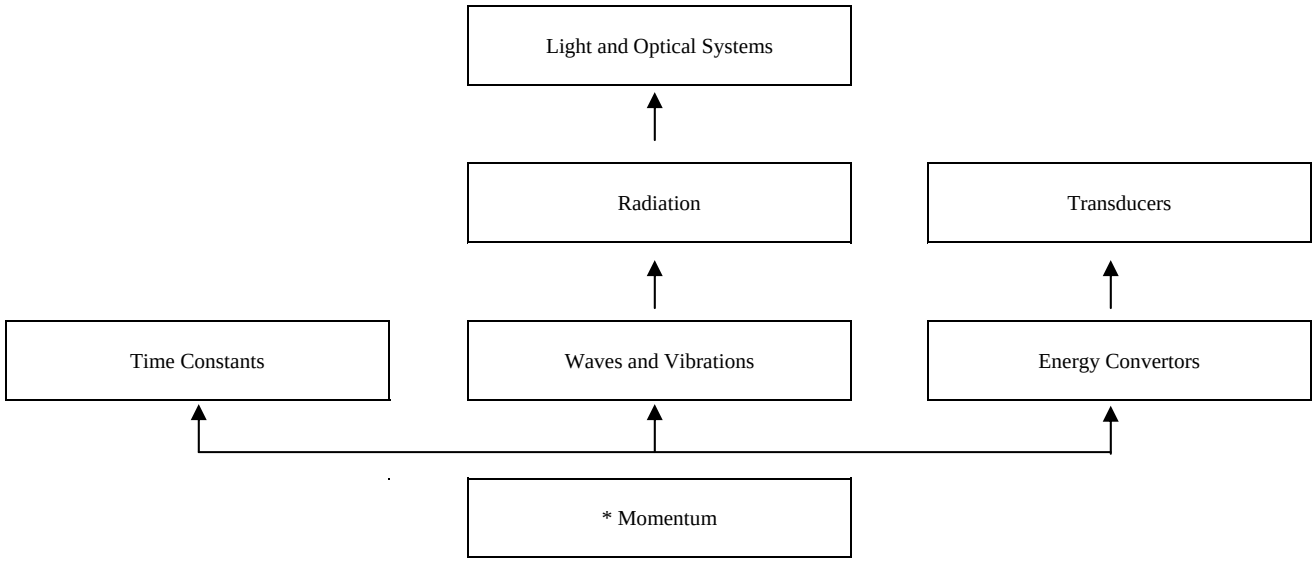
First-Year Units
Suggested Sequence



Second-Year Units
Numerical Sequence



Second-Year Units
Numerical Sequence



Note: Momentum must be taught first before choosing <u>any</u> of the other sequences.

B. Treatment of Content

I. Whenever possible, technical concepts are related to technicians and devices in the context of the workplace.
2. A wide range of technicians and devices are shown.
3. The video and print correlate in terms of textual and graphic illustrations.
4. Terminology is consistent in project components.
5. Language and reading level are appropriate for high school vocational/technical students.

What's the Suggested General Teaching Plan?

Each of the 14 technical concepts is covered in a unit of study. The suggested teaching plan generally requires 26 classes of 50 minutes each for each unit. (See Table below.)

General Teaching Plan

	Unit - Overview Class 1	O					
Mechanical Systems	Subunit 1 Class 2 - 7	C1	C2	M	L1	L2	R
Fluid Systems	Subunit 2 Class 8 -13	C1	C2	M	L1	L2	R
Electrical Systems	Subunit 3 Class 14 - 19	C1	C2	M	L1	L2	R
Thermal Systems	Subunit 4 Class 20 - 25	C1	C2	M	L1	L2	R
	Unit Summary Class 26	S					

Legend:
O: Unit Overview/Video
C1, C2: Video, Classroom Discussion, Demonstration
M: Math Skills Laboratory
L1, L2: Laboratory Practice
R: Review of Current Subunit
S: Unit Summary/Video

This is a general plan. Different units will have different plans. Thus, Unit 1, "Force," is preceded by an extra class that provides an introduction and overview of the entire course. After this initial class, the general plan is the same. In subsequent units, the first class is devoted to an introduction and overview of the unit-rather than the course. This "Unit Overview" class is, of course, shown in Table 1. (See the Breakdown of "Force" at the beginning of Unit 1.) The teaching pattern depends on how many subunits are included in the unit.

The last class of each unit-generally the 26th class-is designed for a unit review/summary and test. The 24 or so intervening classes are divided into four subunits of six classes each.

Each subunit is dedicated to the study of a particular technical concept, such as force, power, rate, etc. in one of the four energy systems under consideration-such as mechanical, fluid, electrical or thermal. For example, the first subunit of six days in Unit 1, "Force," is devoted to the study of force in mechanical systems. The next subunit of six days in Unit 1 is devoted to a study of pressure (a force like quantity) in fluid systems. Subunit 3 covers voltage in electrical systems, Subunit 4 is a study of temperature in thermal systems. The following is an explanation of each designator and the activities associated with each designator.

1. Class Designators shown in the above table have the following interpretations:

DESIGNATOR	INTERPRETATION
"O"	The first class for each unit is devoted to an overview (0) of the unit. A video program is shown, a class discussion conducted, and a reading assignment given.
"C"	During the second class (Cl), students views a video program, discusses both the video program and their previous reading assignment, and are given a new reading assignment.
"C2"	During the third class (C2), students observe a teacher demonstration, discuss this and their previous reading assignment, and complete the Student Exercises in the textbook. The teacher reviews student mastery of Student Exercises with the students. Reading assignments for the topics to be covered in the next class, the Math Skills Lab (M), should be made by the teacher.
"M"	The fourth class-the Math Skills Lab (M)-consists of practice activities to strengthen those mathematical skills students need to deal with the technical content presented in "Cl" and "C2" classes. During this class, the teacher guides students through a series of examples and problems in the math practice exercises. At the end of this class, the teacher assigns students to groups in preparation for the application labs (Ll and L2), and assigns material to be read in preparation for each lab.
"L1"	The fifth class is the concept application lab (Ll). The teacher overviews lab one for the entire class. Then the entire class, working in small groups, may complete lab one. Students are given a reading assignment to prepare them for L2's activities.
"L2"	During the sixth class, concept application laboratory two (L2), students complete the lab not worked on during concept application lab one.
"R"	The seventh class consists of a review (R) and an optional test. The teacher gives the reading assignment from the next subunit.
Subunits 2, 3 and 4	The eighth through twenty-fifth classes repeat the pattern (0, Cl, C2, M, Ll, L2, and R) but focus on different energy systems.
"S"	The twenty-sixth class (S) provides for a unit summary/review and optional test that covers the unit.

II. Time Allocations

A. Classroom instruction, mathematics laboratories and application labs are designed for 50-minute class periods.
B. Classes may be combined, depending on your school's administrative requirements.
C. Each student study assignment will require about 30 minutes.
D. The teacher's preparation for each period during the initial year should range from 30 to 50 minutes.

Ill. Equipment Requirements

In the process of identifying and selecting equipment for the application laboratories, consideration has been given to cost factors, the utility of equipment for multi-use and the equipment's adaptability for learning/illustrating the technical concepts presented in *Principles of Technology*.

IV. Speaking of Problems

Note again, that this information is only a guide and cannot substitute for your own experience and ingenuity in solving problems that may arise in teaching this-or any other-course. Here are samples of some of the problems that have come up and some of the solutions discovered by *Principles of Technology* teachers.

"What if the class falls behind schedule?"

In this case, you might combine two classes, Cl and C2 for example, but you should avoid changing the suggested sequence of instruction. (But don't forget, the schedule is just a guide.)

"What if there are too few labs stations, say three for15 students?"

In this case, you might have students take turns, doing labs on different days; you might have students work together in pairs or teams; or you might divide the class in half, part of them doing one lab while the rest are doing another and then changing places

"What if there's a wide diversity of student ability?"

Many PT teachers have discovered that this situation provides a perfect opportunity to utilize peer teaching, teaming, team teaching, applied learning and corporative learning.

"What if I feel weak in teaching physics or mathematics?"

In this case, you might want to arrange to team teach the course with a physics or mathematics teacher or arrange for a physics or have mathematics teacher to come in only when needed as a resource person.

Other sources of help include your principal, other administrative personnel, other teachers who have already taught *Principles of Technology,* colleagues who are implementing *Principles of Technology* in other schools, your state or provincial consortium representative-as well as CORD and/or AIT.

If you need help with *Principles of Technology*, contact your state or provincial consortium representative or call CORD at 1-800-231-3015. CORD developed the print portions of the course. Call AIT at 1-800-457-4509. AIT developed the videotapes.

It's to your advantage to explore the nature and availability of these potential sources of help even before you need help on a serious problem. You will then know to whom you can turn and what help you can expect when the need arises.

And now, best wishes for a good experience in teaching *Principles of Technology*. We hope that you find satisfaction in knowing that you are one of those who work to advance education, who prepare students for the new "technological society," and who find personal enjoyment in teaching this course.

Principles of Technology

Tips Concerning Successful Lab Management

Just as good management makes good business, good lab management makes good labs. About 40 percent of this course is spent in hands-on physics labs; therefore, we suggest that about 40 percent of your instructional preparation be spent in facilitating this aspect of the course.

Lab time fosters student learning in other course components. The lab gives students a chance for experimentation. Lab time is also a time for students to learn work habits that will benefit them on the job in their future careers. After all, technicians are responsible for maintaining, operating and servicing equipment that keeps technology moving. The lab component of this course is important to developing skills that are necessary for good technicians. Therefore, *Principles of Technology* labs present an introduction to the "real world of work" and serve important training functions for students who plan careers as technicians.

This doesn't mean that a clean, businesslike, bright and organized lab must also be as quiet as a study hall--to the contrary. Noise means learning is taking place. However, there are acceptable noise limits that the teacher should know. Too much noise is obviously detrimental to learning. But the right level of noise indicates activity--that something it happening, that an excitement is taking place about learning. Like Tom Sawyer painting the fence, students involved in a vibrant, exhilarating lab will attract new students who want to see what all the fun is about.

However, you'll also want to be aware of noise outside the lab--the drill team practicing, the band getting ready for a concert, etc. Outside noise is not desirable, and can be controlled with acoustics and other measures. Obviously, the lab should be properly heated, air-conditioned and ventilated.

As you already know, physical discomfort breeds behavior problems. You'll also want to be sure the lab is properly lighted, since ill lighting promotes an unsafe and inefficient place to work. When you begin teaching *Principles of Technology* you may wish to set up all the lab activities yourself. Later on, you might want to allow some of your more capable students to help you set up the labs for the other students. Once you've developed your students' ability to help you set up equipment, you'll have more time to assist students in other activities

In fact, you may want to use this same procedure for setting up the equipment for demonstrations. In other words, you may want to allow some of your most capable students to perform the demonstrations for the class. This has the benefit of giving your students the opportunity to take responsibility for the kinds of duties they may face during their careers as technicians.

This practice in performing-before their peers may also help your students develop public speaking skills and confidence in their ability. As your class begins to become accustomed to the course, you may wish to involve them further in setting up the equipment for all of the lab

activities. Obviously, this will give your students a chance to try their hands at coordinating the kinds of skills that are necessary in the marketplace.

Even though *Principles of Technology* labs are more like physics labs than vocational shops. You may wish-to initiate a checkout procedure for lab equipment so that students can check out equipment, set it up and do-the activities called for in the text during a "free lab time." This time can be taken during their study hall, before school or after school --provided there is someone to supervise the lab. Nothing should go on in the lab unless there's a teacher there to supervise students.

However, students will feel more responsible for the lab if they're required to be responsible-for more than lab clean-up duties--if for example, they're allowed to help maintain the lab. Students should help you provide routine care through day-to-day inspection, doing-general cleaning and making minor adjustments. As mentioned earlier, as the course progresses, students can assist in lab setup. This is sound training for future technicians.

It's also important that you know at all times what equipment is in stock, so you may also want to set up an inventory system to keep a record of equipment items. Inventory records will help you prepare budgets from year to year and plan for the purchase of additional' equipment, as well as help you be aware of losses due to breakage or theft. If you have access to a computer, you may wish to keep your equipment records on a computer. This would allow to you record any discrepancies at once. Computer records also would allow you to update the list as often as you wanted to.

Other lab management tips you may wish to consider are:

- Don't assume your students really know how to use a meter or any of the other instruments in the lab. You may want to give "practical" exams to test students on their ability to use the equipment by having them operate it while you observe then.
- In many cases, students will work together on labs. You should keep tabs to see that the distribution of work is rotated (to eliminate the possibility of one student having all the fun). You may also want to rotate partners or make sure students take turns doing the same experiment or different experiments.
- There are some times when students must rotate between labs. There are other times when students will all be doing the same thing at the same time. Sometimes, they'll use the same equipment, but will do different things. Be sure to point out, and emphasize, these distinctions to your students.
- There are also labs where there will be only one lab setup for the entire class. This is a case where the lab portion is more like a detailed, highly structured demonstration. Students must still participate, however, if the lab is to be used to its best advantage. Students can take data or take turns doing some portion of the lab so that they can see what's happening first hand.
- The first time you teach, you should do the lab yourself before you have the students do it. This way, you can find any surprises or variation. Some surprises may be helpful in structuring a more creative lab than you find in the text.

- The labs in the text are written to a large general audience. Therefore, there may be times when you can add to the lab in the book by adapting labs according to available equipment at your location. As you know, these labs were written with equipment cost- and availability in mind. You may have equipment that can be used to demonstrate the ideas in the lab in different ways.
- Remember: the purpose of these labs is twofold. You don't just want your students to see the experiment. You also want your students to get practice in setting up the equipment and using it. You're trying to get your students to think with their hands as well as with their minds. This is because technicians in the workplace will need both kinds of skills and will need pre-employment practice at coordinating these capabilities.
- Compressed air and vacuum can be provided - by the use of portable manual or electric pumps. Gas can be provided by portable torches or bottled compressed gas, connected by hose to a burner. The decision to use portable alternatives in place of permanent installation of pipes is usually based upon frequency and quantity of use, economic considerations and convenience.
- Water service can be a particularly troublesome problem in retrofitting a room for lab use. It's little trouble to bring water in; the difficulty is in getting the water out. Traditionally, the drains need to be installed either below floor level or through a wall. If a drain is installed into the floor, cutting a trench in a cement floor can be very costly. Taking the drain through a wall results in the use of peninsula lab benches rather than the more efficient island lab benches. One innovation in retrofitting that has not been thoroughly explored is the use of a drain basin below a lab sink fitted with a sump pump; this may simplify the removal of water from a retrofitted lab.

What about safety?

The issue personnel safety, equipment safety, and security-is of increasing concern. Society's growing awareness of hazards and the increased willingness of many citizens to pursue damages through legal action also motivate attention to safety.

The lab is an area of increased hazard. Therefore, you should place much emphasis on safety. This emphasis can be accomplished through the installation of safety devices and the enforcement of safety procedures. We've already cited the use of circuit breakers and separate disconnect switches for each circuit of each bench. In addition, the main room lights should be isolated from any other electrical circuits. There should be an emergency electrical disconnect switch for all electrical circuits in the lab except for the main room lighting circuit. This emergency switch should be wired to deactivate all gas and water utility services and to activate an alarm. Such an arrangement is called a "scram circuit." The scram switch should be placed near the main room exit, and can be placed behind a breakable glass window in order to discourage pranksters.

Many other safety precautions should be routine. Cabinets, drawers and separate storage areas should be locked when not in use. Students should be required to memorize and practice certain basic safety procedures. Personal protective equipment such as aprons, safety glasses, gloves, etc., should be provided and required as conditions warrant. There should never be fewer than

two people in an area when experiments are being performed. (The buddy rule is particularly important when high voltages are present.)

No lab work should be performed in the absence of qualified supervisory personnel. Instructors are responsible for conducting lab experiments and being familiar with the various federal, state and local laws and regulations governing the safe use of all hazardous equipment. Many states also have regulations governing the availability and use of safety devices in school labs. We must recognize that the potential for injury is greater in the lab than in the classroom and be willing to take extra steps to protect the students for whom we are responsible.

What kind of tools will students use?

The tools required for experiments performed in the clean labs are generally light-duty and small in size. A few small power tools may be employed, and hazardous electrical currents can occur with these tools. They should be double insulated and have a proper grounding wire. A station of lockable drawers that are inventoried when opened and closed by the lab assistant can achieve either through a central tool check-in/ checkout system or storage and control of tools. Most tools required in clean labs will fit in a standard 5 1/2" x 6" x 18" drawer; thus, one drawer at - each lab station can be outfitted and designated for this use.

Principles of Technology

Tips Concerning Lab Design and Facilities Consideration

When equipment is used to teach specific principles, it's essential that some real apparatus--typical of that used in today's work places--also be used. It's not enough to demonstrate the principle alone; students must see and understand the principle as applied with the standard apparatus currently used in the technology. Students also must learn how to use the current apparatus.

Principles of Technology has been designed with a strong emphasis on lab experiences. PT requires up to three times the number of laboratory hours, as do the same subject courses in many traditional curricula; therefore, lab facilities must be considered carefully. PT labs are discussed here with respect to size, utility services, storage, furniture arrangements and safety considerations. Both new construction and retrofitting of existing facilities are covered in this discussion.

What are "clean" laboratories?

Principles of Technology labs are classified as “clean” labs. This means they're typified by:

- apparatus that's portable and easily assembled disassembled and stored.
- Light duty tools and few power tools.
- student work surfaces and tables that do not require hardened surfaces or heavy construction.
- environment of room similar to that found in the traditional classroom: drop ceiling, fluorescent lighting, and linoleum floor coverings.
- little or no use of oily or corrosive liquid substances during lab experiments.

What size should the lab be?

The major factors in the selection or construction of a clean lab facility include: (1) student load, (2) apparatus requirements, (3) experimental format, (4) single versus multiple-purpose, and (5) dedicated subject use versus multiple-subject use. Except for apparatus requirements, all of the factors listed may vary from school to school.

The optimal student load for a lock-step experimental format is between 12 and 18 students. A self-paced experimental format permits the school a greater degree of flexibility in determining the size of the lab facility. Generally clean laboratories should have a minimum space allotment of 40 square feet per student. This allotment includes work area, storage space and access space and is stipulated for lab rooms intended as lab rooms only.

However, even if no computer is available, you can keep your equipment records on index cards. You may wish to ask a student to help you in this endeavor as well. This will give the student

training in computer use and/or inventory control, and will provide you with some help in maintaining *your* lab equipment records.

What about furniture arrangements?

Clean lab furniture is generally found in two basic designs: low-form and standard. Low form furniture is 28 to 30 inches from the floor to the top working surface and is intended to be used by students who are seated. Low form furniture may or may not have drawers or cabinets; normally, this design has a composition surface. Traditional or standard furniture has a floor-to-working-surface distance of 36 to 38 inches and normally has storage space (drawers and cabinets). This lab furniture may-be placed against the walls, jutting out into the room in peninsula fashion or it may be isolated from the walls in an island style. As mentioned previously, the island style provides the greatest efficiency and maximum flexibility. Many companies manufacture lab furniture with-various arrangements of storage areas and utility service outlets.

Lab furniture can provide a great deal of room for storage of materials, but it may not provide a total solution. If additional storage space is needed, tall cabinet storage along walls may help. In some instances, a separate area may be dedicated to storage. In all instances, the issues of security and safety must be given serious consideration. It is recommended that a multiple purpose classroom have a minimum of 40 square/feet of laboratory space and 15 square/feet of classroom space for each student. For rooms to be used as labs for *more* than one subject, additional storage space must be provided for experimental apparatus.

What are the utility service requirements?

When the maximum number of lab workstations has been identified and the size of the rooms determined, the requirements for utility services should be considered. Utility services include: electricity for outlets and lighting, compressed air, water and drain. Related considerations are the number of connections to each required service, the arrangement of service connections, and the safety devices and precautions built into the utility service systems.

Electricity provides power for lighting and for activating many devices used in lab experiments. Most electrical service for clean labs is single phase, 120-volt ac. The amount of light needed at bench-top surface varies with the Subject and often with the type of work to be performed. A general rule of thumb is that it should never be less than 100 candlepower or the amount stipulated by state/municipal regulations. Fluorescent lighting that's set diagonally to the orientation of work surfaces maximizes the amount of light reaching the work surface, regardless of -the student's position. The lighting circuits should' be isolated from those circuits that provide power to outlets present in the lab.

Electricity must be delivered at workbench outlets according to a unique scheme. Each workstation should have its' own circuit or circuits, each protected by its own circuit breaker. This arrangement prevents the disruption of power at all lab stations when one circuit becomes overloaded. Each outlet should be color-coded as to circuit. The circuit breaker may be located

remotely from the bench; however, cutoff switches for each circuit should be located at one end of the bench.

Clean labs will require the piped utility services of compressed air, water and drain. Some of these services can be provided without the permanent installation of pipes.

Tips Concerning Equipment Purchases

Principles of Technology is a lab-intensive class. The program has been designed so that 40% of a student's time in any subunit is spent in a “hands on” lab situation. At the end of this course, a student will have experienced about 90 labs. In these 90 labs, the student will have been exposed to nearly 200 individual items.

The *Principles of Technology* teacher's responsibility includes procuring equipment items, identifying them, storing them and maintaining them. This is a large task. You're will be responsible for getting part or catalog numbers, prices and sources of supply. To aid you in the task of constructing your order lists of equipment, we recommend the following steps:

- order your equipment catalogs from Energy Concepts, Lab-Volt, etc.
- order regular science supply catalogs from Sargent-Welch, Cenco, Fisher Scientific, etc.
- order normal Career and Technology supply catalogs from Brodhead Garrett, Kevin Electronics, Pitsco, Midwestern or SASCO
- order general supply catalogs from vendors such as W. W. Grainger, Inc.
- while waiting for your catalogs, review the equipment list and the labs to gain a '”feel” for the lab component of *Principles of Technology*
- consider your equipment suppliers. What's their track record? What service after the sale do they provide? How do they handle damaged or defective items? Do they have someone who is technically knowledgeable about the items they offer (that you can contact)? Do they offer package' deals? Do they give discounts for quantity?
- submit your lists--and be ready to justify each item. You might consider sitting down with your school's purchasing director and work for his/her cooperation in not allowing the order to be based only on price. Be flexible on where the equipment item comes from, but don't compromise on the capabilities of the item.

Memorandum

DATE: April 17, 2000

TO: The Teacher or Administrator Addressed

FROM: Richard Grimsley, Director
Technology Education

RE: *Principles of Technology I & II* Certification Training

Principles of Technology I & II are applied Physics courses designed for tenth through twelfth grade students. *Teachers assigned to teach these courses are required to complete additional certification training. This training is for teachers desiring to teach the Principles of Technology I and II courses. Previously certified Principles of Technology I and II teachers do not need to be retrained.*

Four Texas Education Agency approved *Principles of Technology* certification workshops will be held during the summer of 2000 by the University of Texas at Tyler, through a grant with the Texas Education Agency. Attached, please find information and registration materials regarding these workshops. On the back, please find a copy of the certification requirements for *Principles of Technology I and II* outlined by the State Board of Educator Certification (SBEC) in 1998.

Questions regarding this certification training should be directed to Dr. Paul Roberts, University of Texas at Tyler via e-mail, probertsmail.uttyl.edu, **or by phone at** 903/566-7334**.**

Please disseminate the attached information to any teachers who might be interested in attending:

Effective for the 1998-99 school year the requirements for teaching *Principles of Technology I and II* are:

Principles of Technology I and II may be taught with a secondary certificate and a teaching field in technology education (previously industrial technology education, previously industrial arts), physics or science composite.

All teachers assigned to teach principles of technology shall participate in a Texas Education Agency approved workshop for beginning principles of technology teachers prior to teaching the course. Technology Education teachers must complete 6 semester hours of college physics prior to assignment.

Source: *The State Board of Educator Certification (SBEC) Administrative Rules, 19 TAC Chapter 230, Subchapter U.*

If you do not meet the requirements outlined above, and still desire to complete the training, you will receive a letter of training completion. The certification certificate will be held until all requirements have been completed**. However, teachers who meet all of the requirements outlined above will receive training priority.**

Principles of Technology

Graduation Requirements

Chapter 74. Curriculum Requirements
Subchapter B. Graduation Requirements

Statutory Authority: The provisions of this Subchapter B issued under the Texas Education Code, §§7.102, 28.002, 28.023, 28.025, 28.054, and 38.003, unless otherwise noted.

---

§74.11. High School Graduation Requirements.

(a) Graduates of each high school are awarded the same type of diploma. The academic achievement record (transcript), rather than the diploma, records individual accomplishments, achievements, and courses completed and displays appropriate graduation seals.

(b) All credit for graduation must be earned no later than Grade 12.

(c) To receive a high school diploma, a student entering Grade 9 in the 1998-1999, 1999-2000, or 2000-2001 school years must complete the requirements of the minimum high school program, as specified in subsection (d) of this section; the recommended high school program, as specified in §74.12 of this title (relating to Recommended High School Program); or the distinguished achievement program, as specified in §74.13 of this title (relating to Distinguished Achievement Program -- Advanced High School Program); as well as the testing requirements for graduation, as specified in Chapter 101 of this title (relating to Assessment).

(d) A student must earn at least 22 credits to complete a minimum high school program. Credit may be awarded without prior instruction under Texas Education Code, §28.023 (Credit by Examination). College Board advanced placement and International Baccalaureate courses may be substituted for requirements in appropriate areas. A student must demonstrate proficiency in the following.

(1) English language arts--four credits. The credits must consist of:

(A) English I, II, and III (English I for Speakers of Other Languages and English II for Speakers of Other Languages may be substituted for English I and II only for immigrant students with limited English proficiency); and

(B) a fourth credit of English, which may be satisfied by English IV, Research/Technical Writing, Creative/Imaginative Writing, Practical Writing Skills, Literary Genres, Business Communication, Journalism, or concurrent enrollment in a college English course.

(2) Mathematics--three credits to include Algebra I.

(3) Science--two credits to include at least one credit from Biology, Chemistry, or Physics. The second credit may be selected from any science course approved by the State Board of Education (SBOE).

(4) Social studies--two and one-half credits. The credits must consist of World History Studies (one credit) or World Geography Studies (one credit), United States History Studies Since Reconstruction (one credit), and United States Government (one-half credit).

(5) Academic elective--one credit. The credit must be selected from World History Studies, World Geography Studies, or any course approved by the SBOE for science credit as found in Chapter 112 of this title (relating to Texas Essential Knowledge and Skills for Science).

(6) Economics, with emphasis on the free enterprise system and its benefits--one-half credit. The credit must consist of Economics with Emphasis on the Free Enterprise System and Its Benefits.

(7) Physical education--one and one-half credits to include one-half credit in Foundations of Personal Fitness.

(A) The school district board of trustees may allow a student to substitute certain physical activities for the one and one-half required credits of physical education, including the one-half credit of Foundations of Personal Fitness. The substitutions must be based on the physical activity involved in drill team, marching band, and cheerleading during the fall semester; Junior Reserve Officer Training Corps (JROTC); athletics; Dance I-IV; and two- or three-credit career and technology work-based training courses.

(B) A student may not earn more than two credits in physical education toward state graduation requirements.

(C) In accordance with local district policy, a school district may award up to two credits for physical education for appropriate private or commercially-sponsored physical activity programs conducted on or off campus. The district must apply to the commissioner of education for approval of such programs, which may be substituted for state graduation credit in physical education. Such approval may be granted under the following conditions.

(i) Olympic-level participation and/or competition includes a minimum of 15 hours per week of highly intensive, professional, supervised training. The training facility, instructors, and the activities involved in the program must be certified by the superintendent to be of exceptional quality. Students qualifying and participating at this level may be dismissed from school one hour per day. Students dismissed may not miss any class other than physical education.

(ii) Private or commercially-sponsored physical activities include those certified by the superintendent to be of high quality and well supervised by appropriately trained instructors. Student participation of at least five hours per week must be required. Students certified to participate at this level may not be dismissed from any part of the regular school day.

(8) Health education--one-half credit of Health 1 or Advanced Health, or Health Science Technology--one credit.

(9) Speech--one-half credit, which may be satisfied by Communication Applications, Speech Communication, Public Speaking, Debate, or Oral Interpretation.

(10) Technology applications--one credit, which may be satisfied by:

(A) the following courses in Chapter 126 of this title (relating to Texas Essential Knowledge and Skills for Technology Applications): Computer Science I, Computer Science II, Desktop Publishing, Digital Graphics/Animation, Multimedia, Video Technology, Web Mastering, or Independent Study in Technology Applications;

(B) the following courses in Chapter 120 of this title (relating to Texas Essential Knowledge and Skills for Business Education): Business Computer Information Systems I or II, Business Computer Programming, Telecommunications and Networking, or Business Image Management and Multimedia; or

(C) the following courses in Chapter 123 of this title (relating to Texas Essential Knowledge and Skills for Technology Education/Industrial Technology Education): Computer Applications, Technology Systems (modular computer laboratory-based), Communication Graphics (modular computer laboratory-based), or Computer Multimedia and Animation Technology.

(11) Electives--five and one-half credits. The credits must be selected from:

(A) the list of courses approved by the SBOE for Grades 9-12 as specified in §74.1 of this title (relating to Essential Knowledge and Skills);

(B) Junior Reserve Officer Training Corps (JROTC) (one to four credits); or

(C) Driver Education (one-half credit).

(e) A maximum of three credits of reading may be offered by districts for state graduation elective credit for identified students under the following conditions. The school district board of trustees shall adopt policies to identify students in need of additional reading instruction, and district procedures shall include assessment of individual student needs, ongoing evaluation of each student's progress, and monitoring of instructional activities to ensure that student needs are addressed. Reading credits may be selected from Reading I, II, or III.

(f) An out-of-state or out-of-country transfer student (including foreign exchange students) or a transfer student from a Texas nonpublic school is eligible to receive a Texas diploma but must complete all requirements of this section to satisfy state graduation requirements. Any course credit required in this section that is not completed by the student before he or she enrolls in a Texas school district may be satisfied through the provisions of §74.23 of this title (relating to Correspondence Courses) and §74.24 of this title (relating to Credit by Examination) or by completing the course or courses according to the provisions of §74.26 of this title (relating to the Award of Credit).

(g) The requirements for high school graduation for students who enrolled in a high school program during or before the 1997-1998 school year shall remain in effect as adopted by the State Board of Education.

(h) Students entering Grade 9 in the 2001-2002 school year and thereafter must complete requirements in Chapter 74, Subchapter D, of this title (relating to Curriculum Requirements).

Source: The provisions of this §74.11 adopted to be effective September 1, 1996, 21 TexReg 4311; amended to be effective October 13, 1997, 22 TexReg 10129; amended to be effective September 1, 1998, 23 TexReg 5675; amended to be effective September 1, 2001, 25 TexReg 7691.

---

§74.12. Recommended High School Program.

(a) General requirements. A student entering Grade 9 in the 1998-1999, 1999-2000, or 2000-2001 school years who wishes to complete the recommended high school program and have the accomplishment recognized on the academic achievement record must complete the following requirements.

(b) Academic core components. College Board advanced placement and International Baccalaureate courses may be substituted for requirements in appropriate areas. Credit may be awarded without prior instruction under Texas Education Code, §28.023 (Credit by Examination). The student must demonstrate proficiency in the following.

(1) English--four credits. The credits must consist of English I, English II, English III, and English IV (English I for Speakers of Other Languages and English II for Speakers of Other Languages may be substituted for English I and II only for immigrant students with limited English proficiency).

(2) Mathematics--three credits. The credits must consist of Algebra I, Algebra II, and Geometry.

(3) Science--three credits. Students may choose three credits from the following four areas. Not more than one credit may be chosen from each of the four areas. All students who wish to complete the recommended high school program are encouraged to take Biology, Chemistry, and Physics to fulfill the requirements of this section.

(A) Integrated Physics and Chemistry;

(B) Biology, AP Biology, or IB Biology;

(C) Chemistry, AP Chemistry, or IB Chemistry; and

(D) Physics, Principles of Technology I, AP Physics, or IB Physics.

(4) Social studies--three and one-half credits. The credits must consist of World History Studies (one credit), World Geography Studies (one credit), United States History Studies Since Reconstruction (one credit), and United States Government (one-half credit).

(5) Economics, with emphasis on the free enterprise system and its benefits--one-half credit. The credit must consist of Economics with Emphasis on the Free Enterprise System and Its Benefits.

(6) Languages other than English--two credits. The credits must consist of Level I and Level II in the same language.

(7) Health education--one-half credit of Health 1 or Advanced Health, or Health Science Technology--one credit.

(8) Fine arts--one credit, which may be satisfied by any course in Chapter 117, Subchapter C, of this title (relating to Texas Essential Knowledge and Skills for Fine Arts).

(9) Physical education--one and one-half credits to include one-half credit in Foundations of Personal Fitness.

(A) A school district board of trustees may allow a student to substitute certain physical activities for the one and one-half required credits of physical education, including the one-half credit of Foundations of Personal Fitness. The substitutions must be based on the physical activity involved in drill team, marching band, and cheerleading during the fall semester; Junior Reserve Officer Training Corps (JROTC); athletics; Dance I-IV; and two- or three-credit career and technology work-based training courses.

(B) In accordance with local district policy, a school district may also apply to the commissioner of education for a waiver to allow credit for appropriate private or commercially-sponsored physical activity programs conducted on or off campus. Such approval may be granted under the following conditions.

(i) Olympic-level participation and/or competition includes a minimum of 15 hours per week of highly intensive, professional, supervised training. The training facility, instructors, and the activities involved in the program must be certified by the superintendent to be of exceptional quality. Students qualifying and participating at this level may be dismissed from school one hour per day. Students dismissed may not miss any class other than physical education.

(ii) Private or commercially-sponsored physical activities include those certified by the superintendent to be of high quality and well supervised by appropriately trained instructors. Student participation of at least five hours per week must be required. Students certified to participate at this level may not be dismissed from any part of the regular school day.

(10) Technology applications--one credit, which may be satisfied by:

(A) the following courses in Chapter 126 of this title (relating to Texas Essential Knowledge and Skills for Technology Applications): Computer Science I, Computer Science II, Desktop Publishing, Digital Graphics/Animation, Multimedia, Video Technology, Web Mastering, or Independent Study in Technology Applications;

(B) the following courses in Chapter 120 of this title (relating to Texas Essential Knowledge and Skills for Business Education): Business Computer Information Systems

I or II, Business Computer Programming, Telecommunications and Networking, or Business Image Management and Multimedia; or

(C) the following courses in Chapter 123 of this title (relating to Texas Essential Knowledge and Skills for Technology Education/Industrial Technology Education): Computer Applications, Technology Systems (modular computer laboratory-based), Communication Graphics (modular computer laboratory-based), or Computer Multimedia and Animation Technology.

(11) Speech--one-half credit, which may be satisfied by Communication Applications, Speech Communication, Public Speaking, Debate, or Oral Interpretation.

(c) Additional components. All students who wish to complete the recommended high school program are encouraged to study each of the foundation curriculum areas (English language arts, mathematics, science and social studies) every year in high school as provided in Option I. Options II and III are provided for students who want to focus on a particular career exploration or the development of an academic interest or artistic talent. College Board advanced placement and International Baccalaureate courses may be substituted for requirements in appropriate areas. The student must choose one of the following options for additional components. Credit may be awarded without prior instruction under Texas Education Code, §28.023 (Credit by Examination), or §39.023(i) (end-of-course tests).

(1) Option I: mathematics, science, elective. The student must demonstrate proficiency in the following.

(A) Mathematics--one credit. The credit must consist of Precalculus.

(B) Science--one credit. Students may select any Science course including Integrated Physics and Chemistry; Biology; Environmental Systems; Chemistry; Aquatic Science; Physics; Astronomy; Geology, Meteorology, and Oceanography; AP Biology; AP Chemistry; AP Physics; AP Environmental Science; IB Biology; IB Chemistry; IB Physics; IB Environmental Systems; Scientific Research and Design; Anatomy and Physiology of Human Systems; Medical Microbiology; Pathophysiology; Principles of Technology I; and Principles of Technology II.

(C) Elective--one and one-half credits.

(2) Option II: career and technology. The student must demonstrate proficiency equivalent to three and one-half credits in a coherent sequence of courses for career and technology preparation, as defined by the local school district. To be included in the recommended high school program, a technology preparation program approved by the Texas Education Agency must meet recommended high school program criteria in English language arts, mathematics, science, social studies, languages other than English, health, fine arts, and technology applications.

(3) Option III: academic. The student must demonstrate proficiency equivalent to three and one-half credits consisting of state-approved courses from language arts, science, social studies, mathematics, languages other than English, fine arts, or technology applications. Students may choose all three and one-half credits from one of the disciplines, or they may select courses among the listed disciplines.

(d) Substitutions. No substitutions are allowed in the Recommended High School Program.

(e) Students entering Grade 9 in the 2001-2002 school year and thereafter must complete requirements in Chapter 74, Subchapter D, of this title (relating to Curriculum Requirements).

Source: The provisions of this §74.12 adopted to be effective September 1, 1996, 21 TexReg 4311; amended to be effective October 13, 1997, 22 TexReg 10129; amended to be effective September 1, 1998, 23 TexReg 5675; amended to be effective September 1, 2001, 25 TexReg 7691.

---

§74.13. Distinguished Achievement Program -- Advanced High School Program.

(a) General requirements. A student entering Grade 9 in the 1998-1999, 1999-2000, or 2000-2001 school years who wishes to complete an advanced high school program (called the distinguished achievement program) and have the accomplishment recognized and distinguished on the academic achievement record (transcript) must complete the following requirements.

(1) Academic core components. College Board advanced placement and International Baccalaureate courses may be substituted for requirements in appropriate areas. The student must demonstrate proficiency in the following.

(A) English--four credits. The credits must consist of English I, English II, English III, and English IV (English I for Speakers of Other Languages and English II for Speakers of Other Languages may be substituted for English I and II only for immigrant students with limited English proficiency);

(B) Mathematics--three credits. The credits must consist of Algebra I, Algebra II, and Geometry.

(C) Science--three credits. Students may choose three credits from the following four areas. Not more than one credit may be chosen from each of the four areas. All students who wish to complete the distinguished achievement program are encouraged to take Biology, Chemistry, and Physics to fulfill the requirements of this section.

(i) Integrated Physics and Chemistry;

(ii) Biology, AP Biology, or IB Biology;

(iii) Chemistry, AP Chemistry, or IB Chemistry; and

(iv) Physics, Principles of Technology I, AP Physics, or IB Physics.

(D) Social studies--three and one-half credits. The credits must consist of World History Studies (one credit), World Geography Studies (one credit), United States History Studies Since Reconstruction (one credit), and United States Government (one-half credit).

(E) Economics, with emphasis on the free enterprise system and its benefits--one-half credit. The credit must consist of Economics with Emphasis on the Free Enterprise System and Its Benefits.

(F) Languages other than English--three credits. The credits must consist of Level I, Level II, and Level III in the same language.

(G) Health education--one-half credit of Health 1 or Advanced Health, or Health Science Technology--one credit.

(H) Fine arts--one credit, which may be satisfied by any course in Chapter 117, Subchapter C, of this title (relating to Texas Essential Knowledge and Skills for Fine Arts).

(I) Physical education--one and one-half credits to include one-half credit in Foundations of Personal Fitness.

(i) A school district board of trustees may allow a student to substitute certain physical activities for the one and one-half required credits of physical education, including the one-half credit of Foundations of Personal Fitness. The substitutions must be based on the physical activity involved in drill team, marching band, and cheerleading during the fall semester; Junior Reserve Officer Training Corps (JROTC); athletics; Dance I-IV; and two- or three-credit career and technology work-based training courses.

(ii) In accordance with local district policy, a school district may also apply to the commissioner of education for a waiver to allow credit for appropriate private or commercially-sponsored physical activity programs conducted on or off campus. Such approval may be granted under the following conditions.

(I) Olympic-level participation and/or competition includes a minimum of 15 hours per week of highly intensive, professional, supervised training. The training facility, instructors, and the activities involved in the program must be certified by the superintendent to be of exceptional quality. Students qualifying and participating at this level may be dismissed from school one hour per day. Students dismissed may not miss any class other than physical education.

(II) Private or commercially-sponsored physical activities include those certified by the superintendent to be of high quality and well supervised by appropriately trained instructors. Student participation of at least five hours per week must be required. Students certified to participate at this level may not be dismissed from any part of the regular school day.

(J) Technology applications--one credit, which may be satisfied by:

(i) the following courses in Chapter 126 of this title (relating to Texas Essential Knowledge and Skills for Technology Applications): Computer Science I, Computer Science II, Desktop Publishing, Digital Graphics/Animation,

Multimedia, Video Technology, Web Mastering, or Independent Study in Technology Applications;

(ii) the following courses in Chapter 120 of this title (relating to Texas Essential Knowledge and Skills for Business Education): Business Computer Information Systems I or II, Business Computer Programming, Telecommunications and Networking, or Business Image Management and Multimedia; or

(iii) the following courses in Chapter 123 of this title (relating to Texas Essential Knowledge and Skills for Technology Education/Industrial Technology Education): Computer Applications, Technology Systems (modular computer laboratory-based), Communication Graphics (modular computer laboratory-based), or Computer Multimedia and Animation Technology.

(K) Speech--one-half credit, which may be satisfied by Communication Applications, Speech Communication, Public Speaking, Debate, or Oral Interpretation.

(2) Additional components. All students who wish to complete the distinguished achievement program are encouraged to study each of the foundation curriculum areas (English language arts, mathematics, science and social studies) every year in high school as provided in Option I. Options II and III are provided for students who want to focus on a particular career exploration or the development of an academic interest or artistic talent. College Board advanced placement and International Baccalaureate courses may be substituted for requirements in appropriate academic areas. The student must choose one of the following options for additional components. Credit may be awarded without prior instruction under Texas Education Code, §28.023, (Credit by Examination).

(A) Option I: mathematics, science, elective. The student must demonstrate proficiency in the following.

(i) Mathematics--one credit. The credit must consist of Precalculus.

(ii) Science--one credit. Students may select any Science course including Integrated Physics and Chemistry; Biology; Environmental Systems; Chemistry; Aquatic Science; Physics; Astronomy; Geology, Meteorology, and Oceanography; AP Biology; AP Chemistry; AP Physics; AP Environmental Science; IB Biology; IB Chemistry; IB Physics; IB Environmental Systems; Scientific Research and Design; Anatomy and Physiology of Human Systems; Medical Microbiology; Pathophysiology; Principles of Technology I; and Principles of Technology II.

(iii) Elective--one-half credit.

(B) Option II: career and technology. The student must demonstrate proficiency equivalent to two and one-half credits in a coherent sequence of courses for career and technology preparation, as defined by the local school district. To be included in the distinguished achievement program, a technology preparation program approved by the Texas Education Agency (TEA) must meet distinguished achievement program criteria in English language arts, mathematics, science, social studies, languages other than English, health, fine arts, and technology applications.

(C) Option III: academic. The student must demonstrate proficiency equivalent to two and one-half credits consisting of state-approved courses from language arts, science, social studies, mathematics, languages other than English, fine arts, or technology applications. Students may choose all two and one-half credits from one of the disciplines, or they may select courses among the listed disciplines.

(3) Advanced measures. A student also must achieve any combination of four of the following advanced measures. Original research/projects may not be used for more than two of the four advanced measures. The measures must focus on demonstrated student performance at the college or professional level. Student performance on advanced measures must be assessed through an external review process.

(A) original research/project that is:

(i) judged by a panel of professionals in the field that is the focus of the project; or

(ii) conducted under the direction of mentor(s) and reported to an appropriate audience; and

(iii) related to the required curriculum set forth in §74.1 of this title (relating to Essential Knowledge and Skills);

(B) test data where a student receives:

(i) a score of three or above on The College Board advanced placement examination;

(ii) a score of four or above on an International Baccalaureate examination; or

(iii) a score on the Preliminary Scholastic Assessment Test (PSAT) that qualifies a student for recognition as a Commended Scholar or higher by the National Merit Scholarship Corporation; as part of the National Hispanic Scholar Program of the College Board; or as part of the National Achievement Scholarship Program for Outstanding Negro Students of the National Merit Scholarship Corporation. The PSAT score may count as only one advanced measure regardless of the number of honors received by the student; or

(C) college academic courses and tech-prep articulated college courses with a grade of 3.0 or higher.

(4) Substitutions. No substitutions are allowed in the Distinguished Achievement Program.

(b) Students entering Grade 9 in the 2001-2002 school year and thereafter must complete requirements in Chapter 74, Subchapter D, of this title (relating to Curriculum Requirements).

Source: The provisions of this §74.13 adopted to be effective September 1, 1996, 21 TexReg 4311; amended to be effective October 13, 1997, 22 TexReg 10129; amended to be effective September 1, 1998, 23 TexReg 5675; amended to be effective September 1, 2001, 25 TexReg 7691.

§74.14. Academic Achievement Record (Transcript).

(a) The commissioner of education shall develop and distribute to each school district and institution of higher education in the state a common academic achievement record and coding system for courses and instructions for recording information on the academic achievement record. Each school district must use the coding system provided by the commissioner.

(b) Each school district must use an academic achievement record (transcript) form designated by the State Board of Education (SBOE). Each district must reproduce the form in sufficient quantities. The form shall serve as the academic record for each student and must be maintained permanently by the district. Each district must ensure that copies of the record are made available for a student transferring from one district to another. The information may be provided to the student or to the district to which the student is transferring or both. To ensure appropriate placement of a transfer student, a district must respond promptly to each request for student records from a receiving school district.

(c) Any credit earned by a student must be recorded on the academic achievement record, regardless of when the credit was earned.

(d) A student who completes high school graduation requirements shall have attached to the academic achievement record a seal approved by the SBOE.

(e) A student who completes all graduation requirements except for required exit-level assessment instruments may be issued a certificate of coursework completion. The academic achievement record will include a notation of the date such a certificate was issued to the student.

Source: The provisions of this §74.14 adopted to be effective September 1, 1996, 21 TexReg 4311; amended to be effective September 1, 2001, 25 TexReg 7691.

Principles of Technology

Instruction Materials

Student Textbooks, Student Research Books, Teacher Guides, Implementation Guides, Text Database and other instruction materials may be purchased from two different sources. Please check with each company for pricing and availability. The suppliers or company are as follows:

C. C. I. Publishing
Educational Sales
P.O. Box 21206
Waco, TX 76702-1206
800-231-3015 (sales)
254-776-3906 (fax)
scroll@educatalog.com email
www.cordcommunications.com:/Store/Contextual_Science/Principles_of_Technology.asp
www.applied-academics.com

Career & Technology Materials
The University of Texas at Austin
Distance Education Center
P. O. Box 7218
Austin, TX 78713-7218
877-663-8752
512-475-8835
512-471-5636 (fax)
careertech@eimc-web.lac.utexas.edu email
www.utexas.edu/cee/dec/careertech/order.html

Principles of Technology

How to Secure Video Tapes & DVD's

The Texas Education Agency (TEA) owns the right to duplicate the videotapes for Principles of Technology. The Texas Education Agency Technology Education unit has the video masters to use in duplicating these tapes for use in Texas public schools. Texas schools may request VHS or DVD of these tapes by copying and detaching the order form below. If you have question or need assistance in securing these tapes, please contact **Dr. Paul Roberts at 903-566-7334 or by email at proberts@uttyler.edu.**

Principles of Technology

MEDIA ORDER FORM

Name	Shipping Address (if different):
Address	
Phone	
Email	

Quantity	Item Description	Unit Price	Total
	Curriculum:		
	DVD - Principles of Technology I (four dvd set)	$48.00	
	DVD - Principles of Technology II (three dvd set)	$36.00	
	VHS - Principles of Technology I (four tape set)	$40.00	
	VHS - Principles of Technology II (three tape set)	$30.00	
	Informational:		
	DVD - Principles of Technology – Overview	$12.00	
	VHS - Principles of Technology – Overview	$10.00	
		Subtotal	
		Shipping	Included
		Balance Due	

Make your check payable to the **Technology Education Grant**

Return your completed form and payment (no PO's please) to:

Dr. Paul Roberts
The University of Texas at Tyler
3900 University Blvd. HPR 240
Tyler, TX 75799

If you have any questions call Dr. Roberts at 903-566-7334 or by email at proberts@uttyler.edu

Principles of Technology 1

Texas Essential Knowledge and Skills

General Requirements The prerequisites for this course are one course in science and Algebra I. To receive credit in science, students must meet the 40% laboratory and fieldwork requirement identified in §74.3 (b) (2) (C) of this title, (relating to Description of a Required Secondary Curriculum). This course is recommended for students in Grades 10-12 and should be taken for one science credit.

Course Description An applied physics course designed to provide a study in force, work, rate, resistance, energy, power, and force transformers as applied to mechanical, fluid, thermal, and electrical energy that comprise simple and technological devices and, equipment. The course reinforces the math applications, a student needs to understand and apply the principles studied.

Knowledge and Skills

1. The student uses a systems approach to investigate mechanical, fluid, electrical, and thermal systems. The student is expected to:
   A) apply the universal systems model to technological activities; and
   B) identify the inputs, processes, outputs, and feedback associated with each of the systems.

2. The student works safely with mechanical, fluid, electrical, and thermal technology. The student is expected to:
   A) master relevant safety tests;
   B) follow safety manuals, instructions, and requirements; and
   C) make prudent choices in the conservation and use of resources and the disposal of materials.

3. The student solves problems, thinks critically, and makes decisions related to technology. The student is expected to:
   A) use specific problem solving strategies:
   B) apply critical-thinking strategies;
   C) apply decision-making techniques to the selection of technological solutions; and
   D) evaluate the impact of technology on scientific thought, society. and the environment.

4. The student applies communication, science, and mathematics knowledge and skills to technological activities. The student is expected to:
   A) prepare technical reports and presentations;
   B) solve algebraic equations;
   C) solve problems in English and System International (SI) units; and
   D) perform unit conversions

5. The student knows the laws governing motion. The student is expected to:
   A) analyze examples of uniform and accelerated motion, including linear, projectile, and circular motion;
   B) generate and interpret graphs describing motion, including the se of real time technology;
   C) formulate the effects of forces on the motion of objects;
   D) develop and interpret a free-body diagram for force analysis; and
   E) identify and describe motion related to different frames of reference.

6. The student knows the concept of force. The student is expected to:
   A) apply examples complex technological devices where force must be controlled, measured or applied;
   B) analyze the relationship among force, pressure, voltage, and temperature;
   C) evaluate and predict what happens to an object when forces on it are balanced and when forces on it are unbalanced; and
   D) measure force in mechanical, fluid, electrical, and thermal systems.

7. The student knows the concept of work. The student is expected to:
   A) relate mechanical, fluid, and electrical to force and movement; and
   B) identify and measure the effects of work done in mechanical, fluid and electrical systems.

8. The student knows the concept of rate. The student is expected to:
   A) analyze rate in mechanical, fluid, electrical, and thermal systems; and
   B) measure, verify, and analyze rate in mechanical, fluid, electrical, and thermal systems.

9. The student knows the concept of resistance. The student is expected to:
   A) identify resistance in mechanical, fluid, electrical, and thermal energy systems;
   B) relate the principle of force divided by rate to resistance in each energy system; and
   C) measure, verify, and analyze resistance in mechanical, fluid, electrical, and thermal energy systems.

10. The student knows the concept of energy. The student is expected to:
   A) identify the nature of energy;
   B) relate potential energy, kinetic energy, and heat energy to the conservation of energy;
   C) distinguish between work and energy;
   D) measure, verify, and analyze energy in each system; and
   E) evaluate different methods of energy transfer that result in an increasing amount of disorder.

I1. The student knows the concept of power. The student is expected to:
   A) define power in mechanical, fluid, electrical, and thermal systems; and
   B) relate the principle of work divided by time to each energy system.

12. The student knows the concept of energy transformation. The student is expected to:
A) observe and describe examples of kinetic and potential energy in mechanical, fluid, and electrical systems; and
B) compare examples of energy transformations in mechanical, fluid, and electrical systems.

Principles of Technology 11

Texas Essential Knowledge and Skills

General Requirements The prerequisite for this course is *Principles of Technology I*. To receive credit in science, students must meet the 40% laboratory and fieldwork requirement identified in §74.3 (b) (2) (C) of this title (relating to Description of a Required Secondary Curriculum). This course is recommended for students in Grades 11-12 and should be taken for one science credit.

Course Description A second year applied physics course designed to study momentum, waves, vibrations, energy converters, transducers, radiation, optical systems, and time constants as applied to mechanical, fluid, thermal, and electrical energy systems. The course reinforces the math applications a student needs to understand and apply the principles studied.

Knowledge and Skills

1. The student uses a systems approach to investigate mechanical, fluid, electrical, and thermal systems. The student is expected to:
   A) apply the universal systems model to technological activities; and
   B) identify the inputs, processes, outputs, and feedback-associated with each of the systems.
2. The student works safely with mechanical, fluid, electrical, and thermal technology. 'Me student is expected to:
   A) master relevant safety tests;
   B) follow safety manuals, instructions, and requirements;
   C) identify and classify hazardous materials and wastes; and
   D) dispose of hazardous materials and wastes appropriately.

3. The student solves problems, thinks critically, and makes decisions related to technology. The student is expected to:
   A) use problem-soling strategies;
   B) apply critical-thinking strategies;
   C) apply decision-making techniques to the selection of technological solutions; and
   D) evaluate the impact of technology on scientific thought, society, and the environment.

4. The student applies communication, science, and mathematics knowledge and skills to technological activities. The student is expected to:
   A) prepare technical reports and presentations;
   B) solve algebraic equations;
   C) solve problems in English and System International (SI) units: and
   D) perform unit conversions.

5. The student knows the laws governing motion. The student is expected to:

A) analyze examples of uniform and accelerated motion, including linear, projectile, and circular motion;
B) evaluate the effects of forces on the motion of objects;
C) develop and interpret a free-body diagram for force analysis; and
D) analyze motion relative to different frames of reference.

6. The student knows the concept of momentum. The student is expected to:
A) identify linear and angular momentum; and
B) relate the conservation of momentum to linear and angular motion.

7. The student knows the concept of waves and vibrations. The student is expected to:
A) identify and evaluate characteristics of wave motion; and
B) demonstrate how waves transmit energy.

8. The student knows the concept of energy conversion. The student is expected to:
A) evaluate the purpose of energy converters;
B) identify converters that change one form of energy to another; and
C) evaluate the efficiency of converting energy from one form to another.

9. The student knows the concept of energy transformation. The student is expected to:
A) identify the function of a transducer;
B) distinguish between an energy converter and a transducer; and
C) identify transducers that change energy signals from one form to another.

10. The student knows the concept of radiant energy. The student is expected to:
A) describe radiation and cite examples;
B) compare fission and fusion in terms of end products, energy, advantages, and availability; and
C) compare and contrast different types of radioactive decay.

I1. The student knows the concept of fight and optics. The student is expected to:
A) identify characteristics of optical devices;
B) analyze the characteristics of light including reflection, refraction, and interference; and
C) interpret the effects of wave characteristics in daily applications, such as lasers and optics in industrial and medical technology.

12. The student knows the concept of time constants. The student is expected to:
A) define a time, constant; and
B) distinguish between a linear and nonlinear increase and decrease of a variable with time.

Principles of Technology
Vendors

The following is a list of those vendors who support fully the official *Principles of Technology* equipment specifications with comprehensive equipment offerings. This list is for information purposes only. No endorsement, approval, or other qualification is intended or implied with regard to the relative merits of supplies, their equipment, or services.

Currently, the following *Principles of Technology* equipment vendors and their dealers are serving the program:

School Specialty
100 Paragon Pkwy.
Mansfield, OH 44905
888-222-1332
888-454-1417 fax

Ted Scarborough
School Specialty
888-222-1332

Energy Concepts, Inc.
595 Bond St.
Lincolnshire, IL 60069
800-621-1247
847-821-1940 fax

Dan Allen
Lab Resources, Inc.
PO Box 73471
Houston, TX 77273
888-963-2200
281-587-2200
281-587-2211 fax

Sargent-Welch Scientific Co.
911 Commerce Court
Buffalo Grove, IL 60089
800-727-4368

Holly Ahern
2208-C Forest Trail
Austin, TX 78703
800-727-4368 x2816
512-494-0001
512-494-0002 fax
