# A PLANNING HANDBOOK FOR INTEGRATING ACADEMIC AND VOCATIONAL EDUCATION

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This handbook has been written by Kirsten Giving, LAUSD. A variety of sources are included and recorded as such.
THE INTEGRATION PROCESS

THERE ARE MANY POTENTIAL RESULTS OF INTEGRATION. THEY INCLUDE:

1. Basic skills and academic content can both increase.
2. Vocational courses can become more rigorous.
3. Academic teaching can improve.
4. Collaboration among teachers and excitement about teaching can grow.
5. The curriculum can become more coherent.
6. Patterns of tracking and segregation can break down.

THE INTEGRATION PROCESS IS AN IMPROVEMENT PROCESS

1. It cannot be accomplished with simple adoption of off-the-shelf materials.
2. It requires a concerted effort at substantive change and cooperation from all levels and all people concerned.
3. It applies ideally to all students—not just vocational students.
4. There is one basic strategy: start simply and move to more complex changes.
5. It is good to remember that complex reforms may take substantial periods of time.

THERE ARE HURDLES THAT MUST BE OVERCOME IN THE PROCESS.

1. Many actors influence the process; often in direct ways.
2. Confusion in existing policies can impede innovation.
3. The complexity of the path to change increases impediments.
4. The desire of a “quick fix” may be self-defeating.
5. Instability of leadership or funding impedes reform.

REQUIREMENTS FOR IMPLEMENTATION

1. Vision and commitment
2. Leadership from teachers and administrators
3. Consistent support from district and state offices
4. Resources, including:
   a. Teacher release time and preparation
   b. Staff development
   c. Curriculum materials
   d. Counseling activities focused on the new integration
   e. Smaller class size
   f. Sophisticated vocational offerings
5. Sustained efforts over a long time period
6. Stability in support

All information from the National Center for Research in Vocational Education (NCRVE).
SCHOOL-SITE ACTIVITIES
THAT CAN HELP TO ENSURE SUCCESS FOR THE INTEGRATION OF ACADEMIC AND VOCATIONAL EDUCATION

GETTING STARTED

1. **Develop** cooperative/collaborative teams of academic and vocation education personnel.
2. **Develop** personal and team commitment.
3. **Develop** the process of consensus and group-work strategies.
4. **Plan** measures for dealing with the stress and time constraints of working collaboratively.

INTEGRATION TEAM ACTIVITIES

1. **Write** Integrated Performance Standards and Integrated Performance Activities.*
   Incorporate SCANS competencies and skills* throughout the academic and vocational course standards. Make sure that the students are acquiring the real skills they need for success in their chosen career. Base assessment on performance.

2. **Work** with advisory committees from the community and business and industry to refine curriculum develop internship/apprenticeship plans, and so forth to ensure that the integrated efforts will meet the needs of business and industry as well as the career goals of the students.

3. **Work** with personnel from your district and State Department of Education to ensure coordination of curriculum, strategies, graduation requirements, and so forth.

4. **Publicize** what you are doing. Have students write articles for the school newspaper and the local newspaper(s) in your community, plan and develop display cases and publicity events, go on field trips, and participate in any other kinds of promotional activities that will make your program the MOST desirable on campus! You may even wish to create a new name for your academy that will make it very appealing to young people.

5. **Participate in** and **lead** professional in-service activities to increase your knowledge base and insight into the curricular efforts which you are leading and participating in.

6. **Make your message** always the same to students at any given time! Let the students know that you as faculty members are all on the same team and that you know them and their needs and interests very well. Also, let them know that you are cooperating in the assessment effort so that not just one person will be evaluating performance.

*For further descriptions and information, please see other parts of this handbook.
STEPS FOR PLANNING AND WRITING THE INTEGRATED CURRICULUM

After your teams have been selected from both the academic and vocational areas, you can begin the process of discussing the writing your school-site integrated curriculum. There are several processes that you will need to go through and certain reference materials that you will need to have on hand as your team begins its writing efforts. The model below is one that is practical and has been proven to have positive results. It is the model used in the integration writing efforts in LAUSD.

1. IDENTIFY THE SUBJECT MATTER AREAS TO BE INTEGRATED

   A. Select one area of vocational education at a time that you have chosen to integrate.
   B. Select one or more academic areas that you want to integrate with that vocational area.

   NOTES:
   1) Keep in mind the possible connections.
   2) Repeat for as many areas as you wish to integrate.

2. SELECT BROAD GOALS, TOPICS, STANDARDS, and/or EXPECTATIONS that have been generally accepted in your state and district. (LAUSD uses the State Model Curriculum Standards and Frameworks, district curriculum, the SCANS Report, input from business and industry, and other references, as appropriate.)

   A. Decide with specific “standards” from the vocation education and academic areas are to be integrated.
   B. Record the subject areas (part 1 above) and “standards” you have selected on the form entitled “Planning, Writing, and Using Integrated Curriculum.” (sample included)

3. WRITE AN INTEGRATED PERFORMANCE STANDARD (IPS).

   A. The first part of an IPS is a statement about the general cognitive process—understand or know. It is the “big picture” of what the students will understand or know, and thus, such words are appropriate in Part 3A. Part 3A is not intended to be a competency and therefore, it cannot be measured as such.
B. Part 3B is a statement regarding a specific behavior such as demonstrate or construct. It is what the students will be doing in order to understand or know. It will also form the basis for their assessment.

When the two parts are combined, the Integrated Performance Standard (IPS) is complete.

INTEGRATED PERFORMANCE STANDARDS:

- Are written in the future tense and in the plural sense.
- Evoke high levels of thinking.
- Invite rich educational activities.
- Leave room for student diversity.
- Reflect a student-centered curriculum.

4. CREATE AN INTEGRATED PERFORMANCE ACTIVITY (IPA).

These are activities developed for classroom use that are authentic (reality based), whenever possible, and that promote the acquisition of the integrated performance standard. They are to be purposefully and appropriately complex, requiring students to apply higher cognitive processes.

INTEGRATED PERFORMANCE ACTIVITIES:

- Engage students and require higher level thinking skills.
- Are complex and educationally powerful.
- Are adaptable to the different needs of students.
- Are strongly linked to the integrated performance standards.
- Are authentic tasks whenever possible.
- Are written in the present tense and the plural sense.
- Are sequenced.

5. PLAN TEACHING STRATEGIES THAT ARE CONSISTENT WITH THE INTEGRATED STANDARDS AND ACTIVITIES.

6. TEACH AND ASSESS STUDENT ACHIEVEMENT.

7. EVALUATE THE INTEGRATED CURRICULUM. Revise as needed to ensure greater student success.

PLANNING, WRITING, AND USING INTEGRATED CURRICULUM

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CHECKLIST TO USE WHEN WRITING INTEGRATED PERFORMANCE STANDARDS AND ACTIVITIES

INTEGRATED PERFORMANCE STANDARD (IPS)
____ Is it written in the future tense and in the plural sense?
____ Does it evoke high levels of thinking?
____ Does it invite right educational activities?
____ Does it leave room for student diversity?
____ Does it reflect a student-centered curriculum?

INTEGRATED PERFORMANCE ACTIVITIES (IPA)
____ Do they engage students and require higher level thinking skills?
____ Are they complex and educationally powerful?
____ Are they adaptable to the different needs of students, including Limited-English-Proficient students?
____ Are they strongly linked to the integrated performance standards?
____ Are they authentic tasks whenever possible?
____ Are they written in the present tense and the plural sense?
____ Are they sequenced?

SCANS COMPETENCIES AND SKILLS
Which SCANS Competencies and Skills are included in the activities (IPA)?

Resources: Time ☐ Money ☐ Material & Resources ☐
Interpersonal Skills: Human Resources ☐ Team Member ☐
Teaching Others ☐ Serving Clients/Customers ☐
Leadership ☐ Negotiation ☐ Cultural Diversity ☐
Information: Acquires & Evaluates ☐ Organizes and Maintains ☐
Interprets & Communicates ☐ Uses Computers ☐
Systems: Understands Systems ☐ Monitors & corrects Performance ☐
Improves & Designs Systems ☐
Technology: Selects Technology ☐ Applies It to Task ☐
Maintains & Troubleshoots Technology ☐
Basic Skills: Creative Thinking ☐ Decision Making ☐
Problem Solving ☐ Seeing Things in the Mind’s Eye ☐
Personal Qualities: Responsibility ☐ Social ☐
Self Management ☐

For further information on the SCANS Competencies and Skills, see their description elsewhere in this handbook.
CONTENT AREA EXAMPLE FROM AGRICULTURE AND SCIENCE

STANDARD FROM VOCATIONAL CONTENT AREA

Students will understand the growth and development of plants, including the functions of plant parts and reproductive systems. (Agriculture III A, Plant Science)

STANDARD FROM ACADEMIC SUBJECT AREA

How do the structures of living things perform their functions, interact with each other, and contribute to the maintenance and growth of the organism? (Life Sciences, A-2)

INTEGRATED PERFORMANCE STANDARD

Students will understand how the parts of reproductive systems of plants interact with each other to contribute to the growth and development of the plants. (A)

They will demonstrate knowledge of these relationships by analyzing the structures and functions of a variety of plant species, grown under differing conditions and the interactions of one part of the plant to another. (B)

INTEGRATED PERFORMANCE ACTIVITY

In cooperative learning teams, the students will grow a variety of plants under differing conditions (cool, hot, warm, varying amounts of water and fertilizer, differing kinds of soil, varying exposures to sunlight, differing disease control efforts, etc. (A greenhouse and/or lath house, as well as open-air locations, will provide excellent variety of growing conditions, when they are available.)

Students will track, on a daily basis, all growing conditions. They will use the scientific method components of observing, communicating, comparing, inferring, and applying. They will maintain observation handbooks. Microscopic analysis will be done, and will be recorded, to determine actual plant part structural differences resulting from differing growing conditions.

Each team will prepare a report of the analysis they made of the differences in plant parts and reproductive systems of plants grown under a variety of conditions. Optional experiences could include tracing, for a specific plant, its history, structural changes over time, and current value as a crop.

Students will make a group presentation about their research in written, technical form and orally present their findings to the class. Reports will include some form of creative visual support of their research. In the report, students will document the relationships of the functions on growth and maintenance of the plants.
CONTENT AREA EXAMPLE FROM
BUSINESS EDUCATION AND LANGUAGE ARTS

STANDARD FROM VOCATIONAL CONTENT AREA

Students will demonstrate the ability to apply proper interview techniques in simulated interviews. (Bus. Ed)

STANDARD(S) FROM ACADEMIC SUBJECT AREA

Students engage in many activities that enhance and improve their oral and aural language abilities. (Lang. Art D18)

INTEGRATED PERFORMANCE STANDARD

The students will understand how practice of the interview process will enhance and improve their ability to present themselves and their ideas and listen to and respond to questions posed by interviewers. (A)

The students will demonstrate their oral and aural skills by participating in one or more simulated interviews. (B)

INTEGRATED PERFORMANCE ACTIVITY

The students will read about and discuss the process of interviewing. They will, if possible, view a video presentation of interviewing techniques.

The students will research one or more careers in a field in which they are interested. They will prepare themselves for a mock interview for a specific job opening. They will practice completing application forms, writing resumes, and answering possible questions.

Within their cooperative learning teams they will practice answering questions that could be posed by an interviewer. The students will then participate in a mock interview with the teacher or a personnel representative from a business. The interviews will be videotaped. Students will analyze their own and team-mates performances, using criteria established earlier.

Students will submit both their application forms and resumes as part of a mark.
STANDARD FROM VOCATIONAL CONTENT AREA

Students will develop a financial plan according to individual/family goals, values, needs, and income. (Home Ec. #7)

STANDARD(S) FROM ACADEMIC SUBJECT AREA

All students learn that writing is a process that includes stages called prewriting, drafting, revising, and editing. (English Language Arts #12)

INTEGRATED PERFORMANCE STANDARD

Students will understand how individual and family situations affect financial planning.

They will write recommendations for a financial plan based on individual-family goals, values, needs, incomes, and other available resources.

INTEGRATED PERFORMANCE ACTIVITY

Pairs of students are presented with a hypothetical individual or family situation with descriptions of its/their goals, values, needs, incomes, and other available resources, along with a current financial plan.

Students are to gather information regarding the effects that possible financial problems (such as the birth of a child) would have on the financial welfare of their subject(s).

Students will prepare a research paper, which follows the stages of writing, that presents an analysis of the financial plan for the individual/family, with recommendations for possible modifications to ensure security.
CONTENT AREA EXAMPLE FORM
INDUSTRIAL EDUCATION AND MATHEMATICS

STANDARD FROM VOCATION CONTENT AREA

The student will understand how to accurately estimate production costs of typical printing jobs. (Graphic Arts)

STANDARD FROM ACADEMIC SUBJECT AREA

Construct and draw inferences from charts, tables, and graphs that summarize data from real world situations. (NCTM #10)

INTEGRATED PERFORMANCE STANDARD

The students will understand that to accurately estimate production costs of typical printing jobs the employee-estimator must be able to infer from charts, tables, and graphs used by printers what the costs of jobs will be.

The student will demonstrate knowledge of the estimation process by completing a bid process for a specific printing job.

INTEGRATED PERFORMANCE ACTIVITY

The students will research one or more typical printing jobs. All customer preferences about visual quality, print size, typeface, paper quality and color, assembly instructions, delivery instructions, along with a customer budget will be included. The students, in their cooperative learning teams, will research all of the components of the printing job, using charts, graphs, and tables applicable to the job. They will draw inferences and information from the data.

They will then present an estimation of the cost of the job. The presentation will include a written estimate and samples of the quality of work typefaces, and so forth. The oral presentation to the class (customer) will use data from the charts as well as real printing examples and convincing arguments as to why “their” firm should be awarded the printing job.
AN IDEA FOR A SENIOR PROJECT

The Senior Project is a way in which some schools nationwide have chosen to integrate academic and vocational education. Each student is required to complete a project in either an academic or a vocational area. All course content at the secondary level focuses on the senior project.

A senior project could develop as follows:

Joanna wants to become an architect. Her aptitude and interests tests that he has taken in her career class shows that this would be an excellent career choice for her. Joanna is on the academic track.

Her senior project is to develop a complete plan for a home. In addition to taking her university requirements, she has taken a variety of courses including an Industrial Technology class in computerized architectural drafting—which she really enjoyed. It reinforced for her to what extent she was going to love her chosen profession.

In the Home Economics department she took a Housing and Interior Design course which provided her with an esthetic sense of housing for all ages and incomes and many practical ideas that go into interpreting family and individual needs into a successful home plan.

She has taken several art courses to sharpen her esthetic perception and her understanding of the history of art and architecture.

In the Agricultural and Environmental Education department, she has taken a course in horticulture so that she would be able to develop a landscape design for her senior project house.

Additionally, this busy student has worked during the summers in an architectural firm, acting as a “go-pher” just to become acquainted with the many activities that transpire in an architectural firm. Needless to say, her senior project was a resounding success to all who viewed and assessed it. Because of her skills in word processing, learned in her Business Education courses, her written analysis was professionally presented. Joanna would be able to show her project to both professionals and educators to indicate her great desire to get a space in an architectural program. Of course, all those “As” in math and physics didn't hurt her chances of being accepted!
EXAMPLES OF LANGUAGE ARTS STANDARDS
Grades 9-12

The following standards reflect the strongest possible professional consensus about the content that every student should be exposed to before graduating from high school.

A. Literature-based Program
   Standards:
   1. Developing ethical, aesthetic, and cultural values
      Students study the central works to develop ethical, aesthetic, and cultural values.
   2. Confronting major social and political issues
      Students confront the major social and political issues, thus acquiring a common body of knowledge embedded in literature.
   3. Participating in an extensive reading program
      Students participate in an extensive reading program supported by a large library system, including classroom, school, and community libraries. Both core works, studies in depth by all students, and “good reads,” selected by students from works included on the extended reading list, make up each student’s reading program.
   4. Selecting a core of literary works for all students
      Personnel in school districts select a core of literary works for all students to encounter. Together, students study some works in depth, and they read some works on their own.

B. From Thought to Language to Expression
   Standards:
   5. Reading core works in depth
      To ensure thorough comprehension, students read the core works in depth.
   6. Comprehending in depth and with sophistication
      Students learn to comprehend in depth and with sophistication the nuances as well as the larger meaning of a variety of works.
   7. Experiencing a variety of literary genres
      Students read and experience a variety of literary genres, including the novel, short story, poetry, drama, biography, and essay.
   8. Learning about other disciplines
      Students learn more about the perspectives of other disciplines, such as science, history, economics, mathematics, and art, and about how their acquisition of language skills in listening, speaking, reading, and writing develops their ability to learn across the entire school curriculum.

C. Listening, Speaking, Reading, and Writing
   Standards:
   9. Responding to the core works
      Students respond actively to the core works through integrated listening, speaking, reading, and writing activities.
   10. Developing a systematic writing program
      All students learn that writing is a process that includes stages called prewriting, drafting, revising, and editing.
   11. Learning the writing process
      All students learn that writing is a process that includes stages called prewriting, drafting, revising, and editing.
   12. Writing cogent, clear, and concise prose
      All students learn to write cogent, clear, and concise prose connected to the literary works they are studying.
13. Developing voice and style
   Students write to develop their own voice and style.

14. Studying conventions of writing
   Through direct teaching, students study the conventions, such as grammar, punctuation, and spelling, when these conventions have not already been acquired through reading, writing, and using oral language.

Varying Students’ Language Arts Experiences

Standards:

15. Participating in oral communication activities
   Students regularly participate in oral communication activities, such as class discussions, panel presentations, and debates on worthwhile topics.

16. Striving for high-quality oral presentations
   Students strive for high-quality oral presentations through an awareness of standards, through class assessment, and through motivation inspired by good models.

17. Modeling effective speaking and listening
   Students are supported and reinforced by the adults in their environment who model and guide effective speaking and listening skills and who exemplify proper respect for diversity of language.

18. Improving oral and aural language abilities
   Students engage in many activities that enhance and improve their oral and aural language abilities.

19. Teaching listening skills
   Listening skills require direct teaching.

20. Applying higher-level thinking in detecting propaganda
   Students apply higher-level thinking such as analysis, synthesis, and evaluation as they detect propaganda techniques.

21. Studying vocabulary in context
   Students study vocabulary words in context—drawn from literature or other disciplines studied.

22. Studying etymology to increase vocabulary
   Students study etymology, the roots and histories of words, as a means of acquiring a larger and more precise vocabulary.

23. Teaching vocabulary as part of instruction in speaking and writing
   Teaching vocabulary should be part of teaching speech and writing as well as comprehension activities.

24. Participating in specialized courses
   Students participate in specialized courses that integrate their skills and allow them to pursue their own interests.

25. Emphasizing new assessment methods and tools
   Assessment methods and tools should be aligned with a new emphasis (1) on substance and actual students' performance; (2) on the integration of writing, comprehension, and speaking; and (c) on contextual acquisition of vocabulary and technical skills.

EXAMPLES OF MATHEMATICE FRAMEWORKS
Grades K-12

Mathematically powerful students think and communicate, drawing on mathematical ideas and using mathematical tools and techniques. Mathematically powerful work is purposeful.

- **Thinking** refers to intellectual activities and includes analyzing, classifying, planning, comparing, investigating, designing, inferring and deducing, making hypotheses and mathematical models, and testing and verifying them.
- **Communication** refers to coherent expression of one’s mathematical processes and results.
- **Ideas** refers to content: mathematical concepts such as addition, proportional relationships, geometry, counting, and limits.
- **Tools and techniques** extend from literal tools such as calculators and compasses and their effective use to figurative tools such as computational algorithms and making visual representations of data.

HIGH SCHOOL MATHEMATICS

National Council of Teachers of Mathematics Standards for High School (Complete descriptions will be found on pp. 136-140 of the Mathematics Frameworks document.)

1. Mathematics as Problem Solving
2. Mathematics as Communication
3. Mathematics as Reasoning
4. Mathematical Connections
5. Algebra
6. Functions
7. Geometry from a synthetic Perspective
8. Geometry from an Algebraic Perspective
9. Trigonometry
10. Statistics
11. Probability
12. Discrete Mathematics
13. Conceptual underpinnings of Calculus
14. Mathematical Structure

THE CONTENT OF A HIGH SCHOOL PROGRAM

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Measurement
Number
Logic and Language

**Suggested Units for the High School Grades**
Representing and Analyzing Physical Change over Time
Measuring Inaccessible Distances
Families of Functions
Mathematics of Geometrical solids
Looking Back at Triangles
Secrets and Information: Encryption and Decryption
LOOKING TO THE FUTURE: INTEGRATING MATHEMATICS WITH OTHER SUBJECTS

Like writing, mathematics has always had a double life; it is a discipline in its own right and also plays a central role in many other disciplines. The role of mathematics in science, history, social science, and vocational education is well known. …Coherent units will be especially useful in creating mathematics programs for newly designed vocational programs. (Many schools are restructuring vocational programs to improve offerings for students who have been enrolled in general education courses.) The formulation of vocationally based units ensures that, even with crowded schedules, students in vocational programs will have solid options in mathematics.

For example, a unit developed around decisions in health care might include the study of risk management, probabilities in treatment choices, resource allocation problems, and inference in medical research.

Other examples of vocationally based units might include machines, electronic technologies, business projections (including the use of spreadsheet software), exploration of data bases, and construction.

Yet integration of mathematics with other subjects is not easy. Haphazard integration can result in serious watering down of the curriculum. The following guidelines address the following important issues in designing an integrated assignment, unit, or course:

1. The assignment, unit, or course should advance learning in each of the subjects integrated.
2. The assignment, unit, or course should focus on curricular goals that are central to all of the subjects integrated.
3. An integrated assignment should be assessed from more than one perspective.

It is not too soon to venture toward more integrated instruction. …At all levels many ideas and skills can be developed in an integrated context. A good place to begin is with a few integrated assignments. As design issues are understood better, units and then entire courses can be developed. In particular, efforts should be made toward producing alternative versions of the core sequence for grades nine through twelve, including interdisciplinary themes, taking care that the alternatives do not water down the standards for mathematical power.

NOTE: Extensive descriptions of the above and the entire high school program are found in the Frameworks documents

EXAMPLES OF SCIENCE FRAMEWORKS
Grades K-12

THEMES
Themes are the big ideas of science, larger than facts and concepts; they link the theoretical structures of the various scientific disciplines. They are a way to integrate the overarching concepts of science into a curriculum, much as theories encompass and connect the basic data and evidence of science.

The major themes of science include:
- Energy
- Evolution
- Patterns of change
- Scale and structure
- Stability
- Systems and interactions

SCIENCE CONTENT—THE BIG QUESTIONS OF SCIENCE

PHYSICAL SCIENCES
A. MATTER
1. What is matter, and what are its properties?
2. What are the basic units of matter, and where did matter come from?
3. What principles govern the interactions of matter? How does chemical structure determine the physical properties of matter?

B. REACTIONS AND INTERACTIONS
1. What happens when substances change?
2. What controls how substances change?

C. FORCE AND MOTION
1. What is motion? What are some basic kinds of motion? How is motion described?
2. What is force? What are the characteristics of forces? What is the relationship of force to motion.
3. What are machines, and what do they do? What principles govern their action?

D. ENERGY: SOURCES AND TRANSFORMATIONS
1. What is energy?
2. What are its characteristics?
3. What do we do with energy? What changes occur as we use it?

E. ENERGY: HEAT
1. What is heat energy? Where does it come from, and what are its properties?
2. How do we use heat energy?

F. ENERGY: ELECTRICITY AND MAGNETISM
1. What are electricity and magnetism? What are they like, and what are their basic properties?
2. How do they interact?
3. How do we use electricity and magnetism?

G. ENERGY: LIGHT
1. How does light enable us to see? What are the sources of light? What is light?
2. What are the properties of light?
3. How do we use light?

H. ENERGY: SOUND
1. Where does sound come from? What are its sources? How can sound be described?
2. How does sound enable us to hear? How do we produce sounds?
3. How do we use sound?

EARTH SCIENCES
A. ASTRONOMY
1. What kinds of objects does the universe contain, and how do these objects relate to one another?
2. How has the universe evolved.
3. How do we learn about the contents and structure of the universe?
B. GEOLOGY AND NATURAL RESOURCES
1. How has plate tectonics shaped the evolution of the earth?
2. How are rocks and minerals formed, how are they distinguished, and how are they classified?
3. What is the history of the earth, and how have geomorphic processes shaped the earth’s present features?
4. What are the responsibilities of humans toward natural resources?

C. OCEANOGRAPHY
1. What is the water cycle? How does the water cycle affect the climate, weather, and life of the earth? How does water affect surface features of the land and the ocean floor?
2. What are the oceans? What are the environments and topography of the ocean bottom? How do the oceans support life, and how have the oceans and their marine life changed through time?
3. How do waters circulate in the ocean, and how does this circulation affect weather and climate?
4. How do humans interact with the oceans? What may be some long-term effects of human interactions with the oceanic environments?

D. METEOROLOGY
1. What are the physical bases of the earth’s climate and weather?
2. What are the major phenomena of climate and weather? What are the large- and small-scale causes of climate and weather?
3. How are we affected by weather? How do we predict it? How can we alter it?

LIFE SCIENCES
A. LIVING THINGS
1. What are the characteristics of living things?
2. How do the structures of living things perform their functions, interact with each other, and contribute to the maintenance and growth of the organism?
3. What are the relationships of living organisms, and how are living things classified?
4. How do humans interact with other living things?

B. CELLS, GENETICS, AND EVOLUTION
1. What are cells? What are their component structures and their functions? How do they grow? What is the biochemical basis of life and of metabolism?
2. How are the characteristics of living things passed on through generations? How does heredity determine the development of individual organisms?
3. How has life changed and diversified through time? What processes and patterns characterize the evolution of life?

C. ECOSYSTEMS
1. What are ecosystems, and how do organisms interact in ecosystems?
2. How does energy flow within an ecosystem?
3. How do ecosystems change?
4. What are the responsibilities of humans toward ecosystems?

SCIENCE PROCESSES AND THE TEACHING OF SCIENCE
The processes of science that form the core of science pedagogy are:
Observing, Communicating, Comparing, Ordering, Categorizing, Relating, Inferring, Applying.

As scientists use these processes in their everyday work, so science teaching should center instruction, particularly hands-on instruction, on these fundamental processes.

WORKPLACE COMPETENCIES

I. RESOURCES

A. Allocates Time
   - Selects relevant, goal-related activities, ranks them in order of importance
   - Allocates time to activities
   - Understands, prepares, and follows schedules.

   **Competent performance in allocating time includes:**
   - Properly identifying tasks to be completed
   - Ranking tasks in order of importance
   - Developing and following an effective, workable schedule based on accurate estimates of such things as:
     - Importance of tasks
     - Time to complete tasks
     - Time available for completion
     - Task deadlines
   - Avoiding wasting time
   - Accurately evaluating and adjusting a schedule.

B. Allocates Money
   - Uses or prepares budgets, including making cost and revenue forecasts
   - Keeps detailed records to track budget performance
   - Makes appropriate adjustments.

   **Competent performance in allocating money includes:**
   - Accurately preparing and using a budget according to a consistent and orderly accounting method
   - Accurately calculating future budgetary needs based on projected costs and revenues
   - Accurately tracking the extent to which actual costs and revenues differ from the estimated budget
   - Taking appropriate and effective actions.

C. Allocates Material and Facility Resources
   - Acquires, stores, and distributes materials, supplies, parts, equipment, space, or final products in order to make the best use of them.

   **Competent performance in allocating material and facility resources includes:**
   - Carefully planning the steps involved in the acquisition, storage, and distribution of resources
   - Safely and efficiently acquiring, transporting, or storing them
   - Maintaining them in good condition
   - Distributing them to the end user.

II. INTERPERSONAL SKILLS

A. Allocates Human Resources
   - Assesses knowledge and skills and distributes work accordingly
   - Evaluates performance and feedback.
Competent performance in allocating human resources includes:
- Accurately assessing peoples’ knowledge, skills, abilities, and potential
- Identifying present and future workloads
- Making effective matches between individual talents and workloads
- Actively monitoring performance and providing feedback.

B. Participates as a Member of a Team
- Works cooperatively with others and contributes to group with ideas, suggestions, and effort.

Demonstrating competence in participating as a member of a team includes:
- Doing own share of tasks necessary to complete a project
- Encouraging team members by listening and responding appropriately to their contributions
- Building on individual team members’ strengths
- Resolving differences for the benefit of the team
- Taking personal responsibility for accomplishing goals
- Responsibly challenging existing procedures, policies, or authorities.

C. Teaches Others
- Helps others learn.

Demonstrating competence in teaching others includes:
- Helping others to apply related concepts and theories to tasks through coaching or other means
- Identifying training needs
- Conveying job information to allow others to see its applicability and relevance to tasks
- Assessing performance and providing constructive feedback/reinforcement.

D. Serves Clients/Customers
- Works and communicates with clients and customers to satisfy their expectations.

Demonstrating competence in serving clients and customers includes:
- Actively listening to customers to avoid misunderstandings and identifying needs
- Communicating in a positive manner, especially when handling complaints or conflict
- Efficiently obtaining additional resources to satisfy client needs.

E. Exercises Leadership
- Communicates thoughts, feelings, and ideas to justify a position
- Encourages, persuades, convinces, or otherwise motivates an individual or groups, including responsibly challenging existing procedures, policies, or authority.

Demonstrating competence in exercising leadership includes:
- Making positive use of the rules/values followed by others
- Justifying a position logically and appropriately
- Establishing credibility through competence and integrity
- Taking minority viewpoints into consideration.

F. Negotiates to Arrive at a Decision
- Works toward an agreement that may involve exchanging resources or resolving divergent interests.

Demonstrating competence in negotiating to arrive at a decision involves
- Researching opposition and the history of the conflict
Setting realistic and attainable goals
Presenting facts and arguments
Listening to and reflecting on what has been said
Clarifying problems and resolving conflicts
Adjusting quickly to new facts/ideas
Proposing and examining possible options
Making reasonable compromises.

G. Works with Cultural Diversity
- Works well with men and women and with a variety of ethnic, social, or educational backgrounds.

Demonstrating competence in working with cultural diversity involves
- Understanding one’s own culture and those of others and how they differ
- Respecting the rights of others while helping them make cultural adjustments where necessary
- Basing impressions on individual performance, not on stereotypes
- Understanding concerns of members of other ethnic and gender groups.

III. INFORMATION

A. Acquires and Evaluates Information
- Identifies need for data
- Obtains data from existing sources or creates them
- Evaluates their relevance and accuracy.

Competently performing the tasks of acquiring data and evaluating information includes:
- Asking analytic questions to determine specific information needs
- Selecting possible information and evaluating its appropriateness
- Determining when new information must be created.

B. Organizes and Maintains Information
- Organizes, processes, and maintains written or computerized records and other forms of information in a systematic fashion.

Competently performing the tasks of organizing and maintaining information includes:
- Understanding and organizing information from computer, visual, oral, and physical sources in readily accessible formats, such as computerized data bases, spreadsheets, microfiche, video disks, paper files, etc.
- When necessary, transforming data into different formats in order to them by the application of various methods such as sorting, classifying, or more formal methods.

C. Interprets and Communicates Information
- Selects and analyzes information and communicates the results to others using oral, written, graphic, pictorial, or multi-media methods.

Competently performing the tasks of communicating and interpreting information to others includes:
- Determining information to be communicated
- Identifying the best methods to present information (e.g. overheads, handouts)
- If necessary, converting to desired format and conveying information to others through a variety of means including oral presentation, written communication, etc.
D. Uses Computers to Process Information

- Employs computers to acquire, organize, analyze, and communicate information.

*Competently using computers to process information includes:*
- Entering, modifying, retrieving, storing, and verifying data and other information
- Choosing format for display (e.g. line graphs, bar graphs, tables, pie charts, narrative)
- Ensuring the accurate conversion of information into the chosen format.

IV. SYSTEMS

A. Understands Systems

- Knows how social, organizational, and technological systems work and operates effectively within them.

*Demonstrating competence in understanding systems involves:*
- Knowing how a system’s structures relates to goals
- Responding to the demands of the system/organization
- Knowing the right people to ask for information and where to get resources
- Functioning within the formal and informal codes of the social/organizational system.

B. Monitors and Corrects Performance

- Distinguishes trends
- Predicts impact of actions on system operations
- Diagnoses deviations in the function of a system/organization
- Takes necessary action to correct performance.

*Demonstrating competence in monitoring and correcting performance includes:*
- Identifying trends and gathering needed information about how the system is intended to function
- Detecting deviations from system’s intended purpose
- Troubleshooting the system
- Making changes to the system to rectify system functioning and to ensure quality of product.

C. Improves and Designs systems

- Makes suggestions to modify existing systems to improve products or services
- Develops new or alternative systems.

*Demonstrating competence in improving or designing systems involves:*
- Making suggestions for improving the functioning of the system/organization
- Recommending alternative system designs based on relevant feedback
- Responsibly challenging the status quo to benefit the larger system.

V. TECHNOLOGY

A. Selects Technology

- Judges which set of procedures, tools, or machines, including computers and their programs, will produce the desired results.

*Demonstrating competence in selecting technology includes:*
- Determining desired outcomes and applicable constraints
- Visualizing the necessary methods and applicable technology
- Evaluating specifications.
- Judging which machine or tool will produce desired results.
B. Applies Technology to Task
   - Understands the overall intent and the proper procedures for setting up and operating machines, including computers and their programming systems.
   **Demonstrating competence in how to apply technology to task includes:**
   - Understanding how different parts of machines interact and how machines interact with broader production systems
   - On occasion, installing machines including computers
   - Setting up machines including computers
   - Setting up machines or systems of machines efficiently to get desired results
   - Accurately interpreting machine output; and detecting errors from program output.

C. Maintains and Troubleshoots Technology
   - Prevents, identifies, or solves problems in machines, computers, and other technologies.
   **Demonstrating competence in maintaining and troubleshooting technology includes:**
   - Identifying, understanding, and performing routine preventative maintenance and service on technology
   - Detecting more serious problems
   - Generating workable solutions to correct deviation
   - Recognizing when to get additional help.

FOUNDATION SKILLS

VI. BASIC SKILLS

A. Reading
   - Locates, understands, and interprets written information in prose and documents—including manuals, graphs, and schedules—to perform tasks
   - Learns from text by determining the main idea or essential message;
   - Identifies relevant details, facts, and specifications
   - Infers or locates the meaning of unknown or technical vocabulary
   - Judges the accuracy, appropriateness, style, and plausibility of reports, proposals, or theories of other writers.

B. Writing
   - Communicates thoughts, ideas, information, and messages in writing
   - Records information completely and accurately
   - Composes and creates documents such as letters, directions, manuals, reports, proposals, graphs, flow-charts
   - Uses languages, style, organization, and format appropriate to the subject matter, purpose, and audience
   - Includes supporting documentation and attends to level of detail
   - Checks, edits, and revises for correct information, appropriate emphasis, form, grammar, spelling, and punctuation.

C. Arithmetic/Mathematics
   - Performs basic computations
   - Uses basic numerical concepts such as whole numbers and percentages in practical situations
   - Makes reasonable estimates of arithmetic results without a calculator
   - Uses tables, graphs, diagrams, and charts to obtain or convey quantitative information.
D. **Listening**
- Receives, attends to, interprets, and responds to verbal messages and other cues such as body language in ways that are appropriate to the purpose; for example, to comprehend, to learn, to critically evaluate, to appreciate, or to support the speaker.

E. **Speaking**
- Organizes ideas and communicates oral messages appropriate to listeners and situations
- Participates in conversation, discussion, and group presentations
- Selects an appropriate medium for conveying a message
- Uses verbal language and other cues, such as body language, appropriate in style, tone, and level of complexity to the audience and the occasion
- Speaks clearly and communicates a message
- Understands and responds and responds to listener feedback
- Asks questions when needed.

**VII. THINKING SKILLS**

A. **Creative Thinking**
- Uses imagination freely
- Combines ideas or information in new ways
- Makes connections between seemingly unrelated ideas
- Reshapes goals in ways that reveal new possibilities.

B. **Decision Making**
- Specifies goals and constraints
- Generates alternatives
- Considers risks
- Chooses best alternative.

C. **Problem Solving**
- Recognizes that a problem exists (i.e. there is a discrepancy between what is and what should or could be)
- Identifies possible reasons for the discrepancy
- Devises and implements a plan of action to resolve it
- Evaluates and monitors progress
- Revises plan as indicated by findings.

D. **Seeing Things in the Mind’s Eye**
- Organizes and processes symbols, pictures, graphs, objects, or other information
  - *For example:* sees a building from a blueprint; a system’s operation from schematics; the flow of work activities from narrative descriptions; or the taste of food from reading a recipe.

**VIII. PERSONAL QUALITIES**

A. **Responsibility**
- Exerts a high level of effort and perseverance toward goal attainment
- Works hard to become excellent at doing tasks by setting high standards, paying attention to details, working well and displaying a high level of concentration—even when assigned an unpleasant task
• Displays high standards of attendance, punctuality, enthusiasm, vitality, and optimism in approaching and completing tasks.

B. Social
• Demonstrates understanding, friendliness, adaptability, empathy and politeness in new and on-going group settings
• Asserts self in familiar and unfamiliar social situations
• Relates well to others
• Responds appropriately as the situation requires
• Takes an interest in what others say and do.

C. Self Management
• Assesses own knowledge, skills, and abilities accurately
• Sets well-defined and realistic personal goals
• Monitors progress toward goal attainment
• Motivates self through goal achievement
• Exhibits self-control and responds, to feedback unemotionally and non-defensively
• Is a “self-starter.”

SOURCE: SKILLS AND TASKS FOR JOBS: A SCANS REPORT FOR AMERICA 2000, United States Department of Labor, 1992. Available from the Superintendent of Documents, Mail Stop: SSOP, Washington, DC, 20402-9328, $27.00, ISBN 0-16-036177-X. NOTE: This SCANS report is designed to help educators make high school courses more relevant to the needs of a modern workforce and to help employers ensure that their employees possess appropriate, up-to-date skills. The guide may be used in two ways—one focusing on the skills and the other on jobs. It is a valuable resource to all curriculum developers!