21st Century Learning Skills and the College and Career Readiness Standards

A Texas Higher Education Coordinating Board Project in Conjunction with:

Stephen F. Austin State University
Department of Secondary Education
and Educational Leadership
College of Sciences and Mathematics

Rural High Schools
Hudson High School
Lufkin High School
Nacogdoches High School
Woden High School

Angelina College
Mathematics and
Science Division

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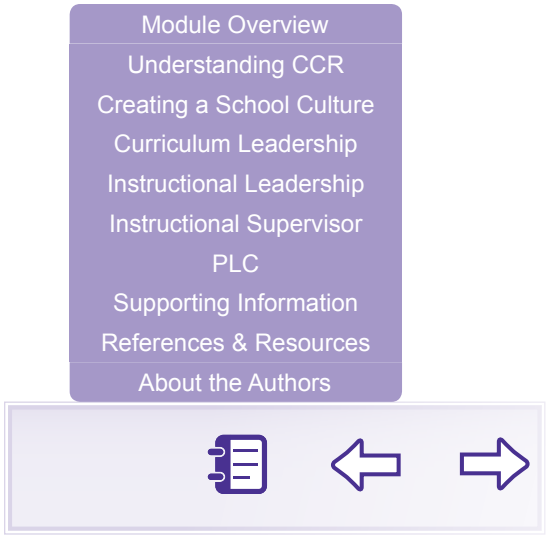

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Module Overview

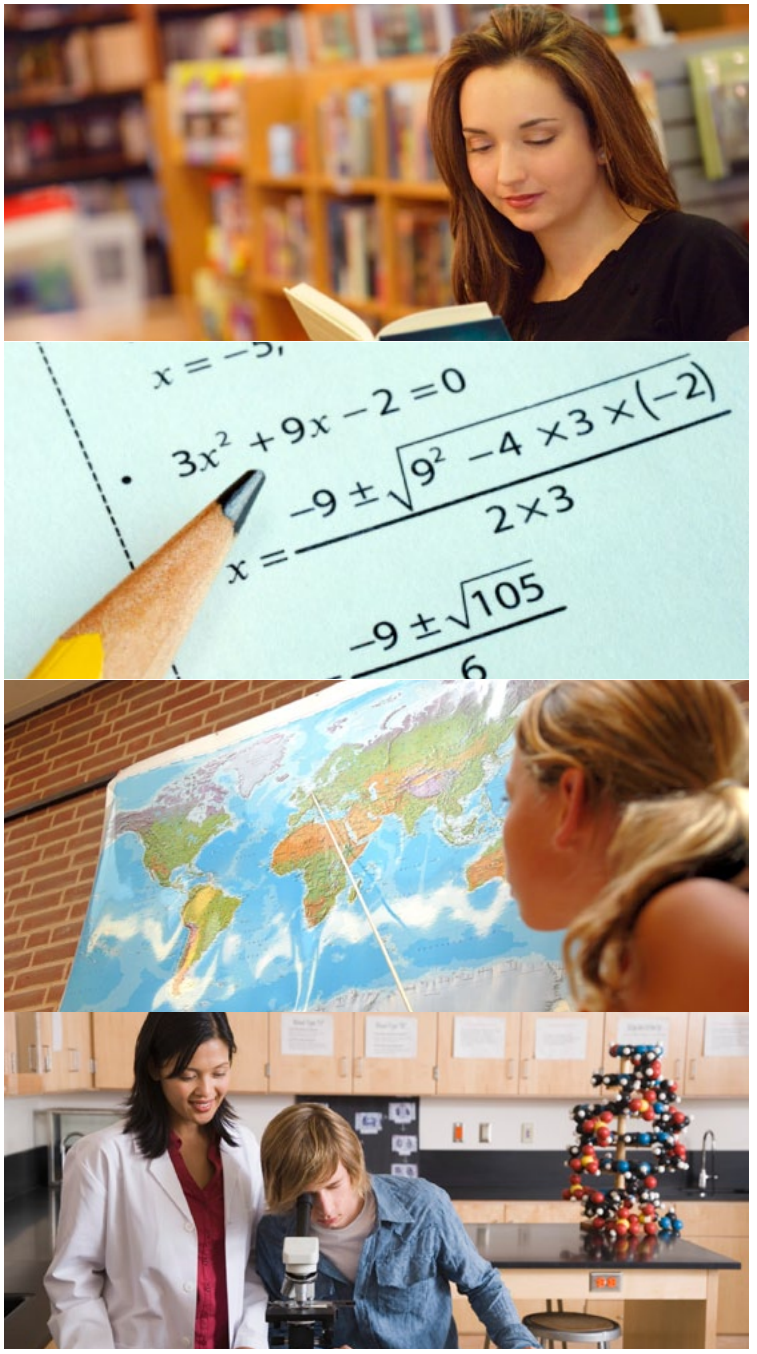
Module Overview

Watch the video 21st Century Learning Skills and the College and Career Readiness Standards.

Module Overview

Students currently attending Texas public schools are destined to enter a globally competitive, highly interactive job market upon graduation, an environment which has no historical precedent. In an effort to meet the challenges imposed by this new economic / employment landscape, the state has developed and integrated the Texas College and Career Readiness Standards (CCRS) into the Texas Essential Knowledge and Skills. These new standards define what students should know and be able to do at entry level, postsecondary environments be they university, college, or career settings. The CCRS focus upon four content areas: English, mathematics, social studies, and science. Additionally, the CCRS address the Cross-Disciplinary Standards, those skills that should permeate all content areas.

As organized, the CCRS define what secondary curricula must accomplish in order to prepare students for post high school realities. With the alignment of the state's secondary curricula to the College and Career Readiness Standards, Texas high school students should attain a higher level of preparation for life after graduation, a future expected to offer an increasingly complex employment landscape. However, certain traditions continue to threaten the curricular innovations of the CCRS, specifically a myopic perspective that envisions only select students as college or career capable while others are destined for vague, less secure work futures.



Module Overview

The reality, as envisioned by the articulation of the CCRS, dictates that today all students must be highly prepared for the dynamic 21st century workplace. Inherent in this vision is the recognition that all students must be ready for postsecondary education or career training that demands the same knowledge, skills, and dispositions as entry level college or university course work. In short, today every student matters and every student must be prepared to be successful in the 21st century employment milieu.

The STEPS (Systemic Teacher Preparation Sites) grant is a collaborative between Stephen F. Austin State University, Angelina College, and four rural high schools located within Hudson ISD, Lufkin ISD, Nacogdoches ISD, and Woden ISD. This partnership collaboratively designed this Module as well as three others for the benefit of pre-service and in-service math and science teachers.

In the course of the grant's initial year of work, participants discovered a sound alignment between high school content and the College and Career Readiness Standards. Yet, challenges remained for those participating in-service and pre-service teachers in their efforts to resolve the following:

1) how to integrate 21st century skills into teacher repertoires,
2) how to embed the cross-disciplinary skills in demonstration lessons,
3) how to teach reading comprehension skills in mathematics and science, and
4) how to generate meaningful assessment examples that mirrored the rigor of classroom content and instruction.

Module Overview

As a result of these challenges, STEPS participants developed learning modules around the four galvanizing areas. These modules are: 21st Century Learning Skills and the College and Career Readiness Standards, The Importance of Using the Cross-Disciplinary Standards in Mathematics and Science, Independent Reading Practices for Mathematics and Science Students, and The Importance of Meaningful Classroom Assessment in Promoting College and Career Readiness.

Each module provides a valuable tool of available research and resources regarding the respective topic, briefly defines key components of the topic, and provides content area examples.

The STEPS team has prepared the instructional module for approximately one to one and a half hours of professional development. The modules are designed as a resource, not an exhaustive compilation of the subject. We recommend that the in-service and pre-service teachers review all four modules

While the module may appear content-dense at first glance, it is designed to be flexible and self-paced providing an opportunity for the reader to review and reflect upon all sections or choose only areas in which they are not familiar or have concerns.

> *"We encourage you, as teachers of Texas students, to incorporate the instructional expectation of the College and Career Readiness Standards into your daily practice; our students are worth it."*
> *(STEPS team)*

Module Overview

This module examines specific 21st century learning skills that today's public school students must possess. These skills should be taught and reinforced throughout the school experience because they are vital to student success in the formal learning milieu and they are essential for adulthood well-being in a media-saturated world characterized by dynamic change and the necessity for lifelong learning.

The STEPS grant views the acquisition of these skills as a necessary component for facilitating student mastery of the College and Career Readiness Standards. These skills are especially relevant to the Cross-Disciplinary Standards in that they directly supplement the foundations of learning and knowing . Therefore, for the purpose of this module, the 21st Century Learning Skills will be correlated to the Cross-Disciplinary Standards of the College and Career Readiness Standards.

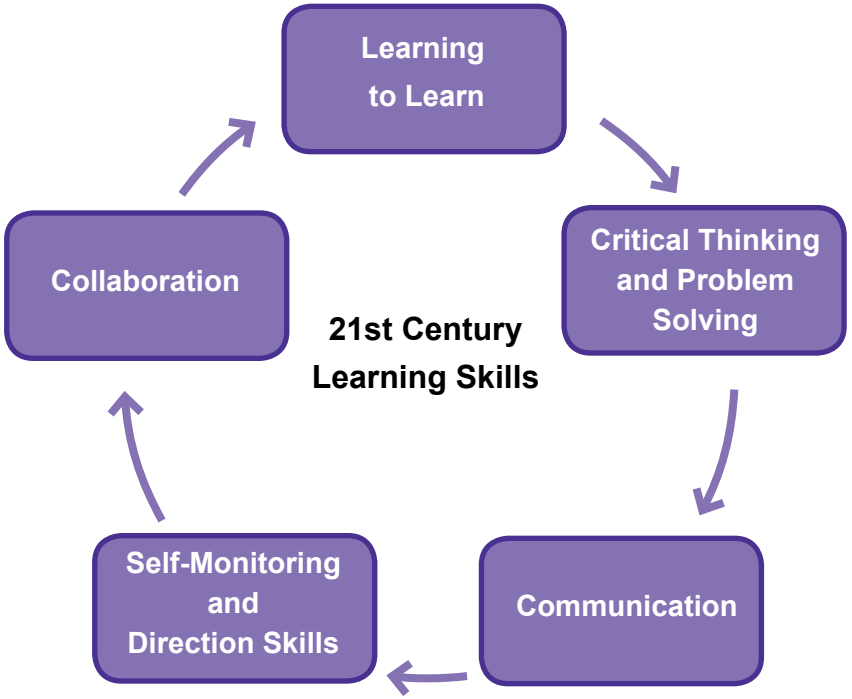


Figure 1

Our new millennium is recognized as vibrantly diverse, global in scope, and positioned on the edge of a seemingly endless technological revolution. The very world for which today's schools seek to prepare students is one which we simply cannot envision nor truly plan for. It is this palpitating ambiguity that drives the core of true educational reform and likewise, impels the acquisition of 21st century skills.

In this module for teachers, grounded in the learning-to-learn theory that flows from the recognition that all people must be capable of continuous learning, Figure 1 lists those skills that are deemed essential for preparing young people for independent, productive, and above all sustainable futures in the 21st century.

Exploring the Cross-Disciplinary Standards

The Cross-Disciplinary Standards are skills that students must apply across all content areas as noted in Figure 2. As stated by the Educational Policy Improvement Center in the College and Career Readiness Standards booklet, “Think of the Cross-Disciplinary Standards as tools that college instructors…use to challenge, engage, and evaluate students…They include key cognitive skills such as reasoning and problem solving as well as foundational skills such as reading, writing, data analysis, and conducting research” *(EPIC, 2008, p. 30)*.

The College and Career Readiness Standards Booklet continues, “Students, then, not only need to possess content knowledge, but also need to be able to apply key cognitive strategies to the academic tasks presented to them, most of which require much more than simple recall of factual knowledge” *(EPIC, 2008, p. 30)*.

Not only are these skills important for postsecondary entry-level success, but they have also been noted as critical to the workplace.

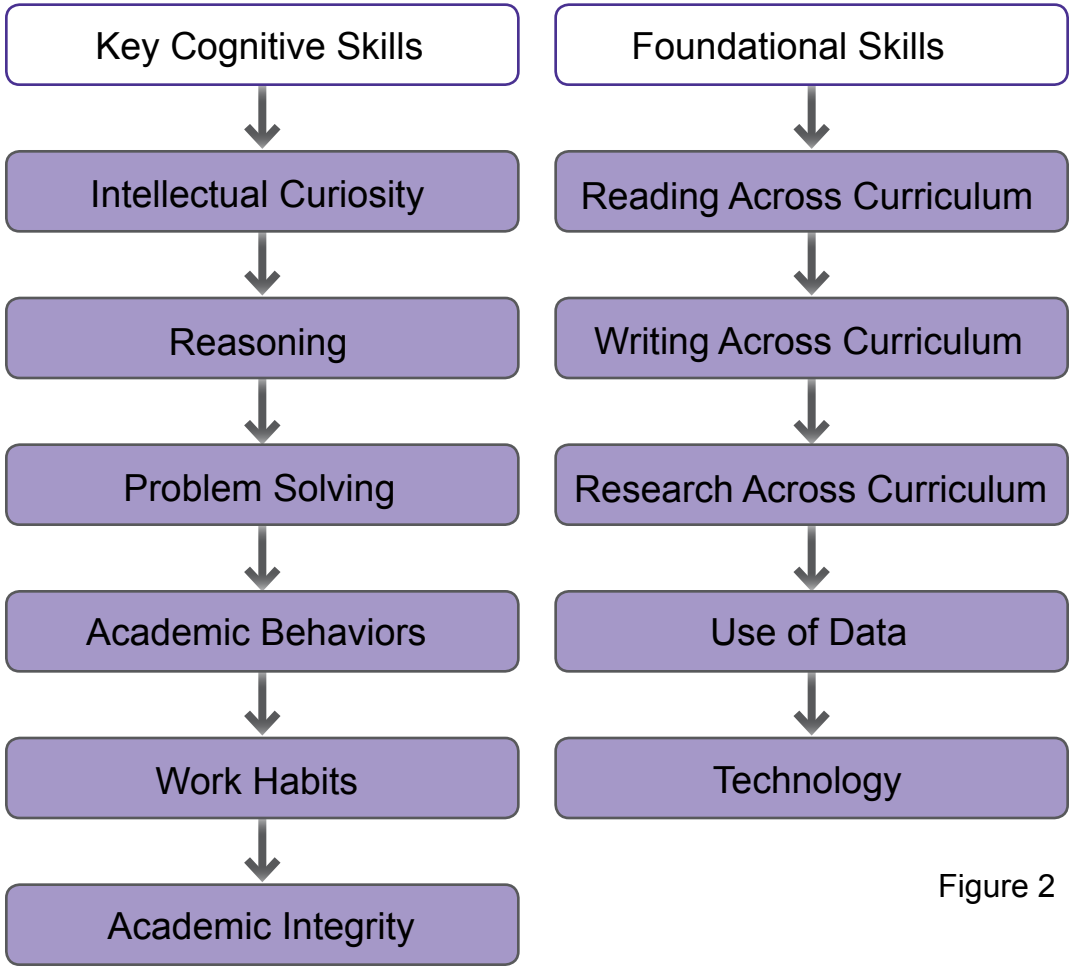


Figure 2

Exploring the Cross-Disciplinary Standards

Importance of Cross-Disciplinary Standards

The College and Career Readiness Standards Booklet defines the importance of Cross-Disciplinary Standards as requirements that "...enable students to engage in deeper levels of thinking across a wide range of subjects. They help high school students prepare for the transition from high school's primary focus on acquiring content knowledge to a postsecondary environment in which complex cognitive skills are necessary to achieve deeper understanding" *(EPIC, 2008, p. 30)*.

The Cross-Disciplinary Standards were developed by teams of postsecondary faculty and secondary teachers who also created performance indicators that show how the Cross-Disciplinary Standards could be demonstrated in a subject area. Throughout this module, we will reference these performance examples.

Learning to Learn

Learning to Learn

Learning to learn is a process of discovery about learning. It involves a set of principles and skills which, if understood and used, help learners learn more effectively and so become learners for life. At its heart is the belief that learning is learnable.

Figure 3 briefly details what the awareness of learning to learn offers students.

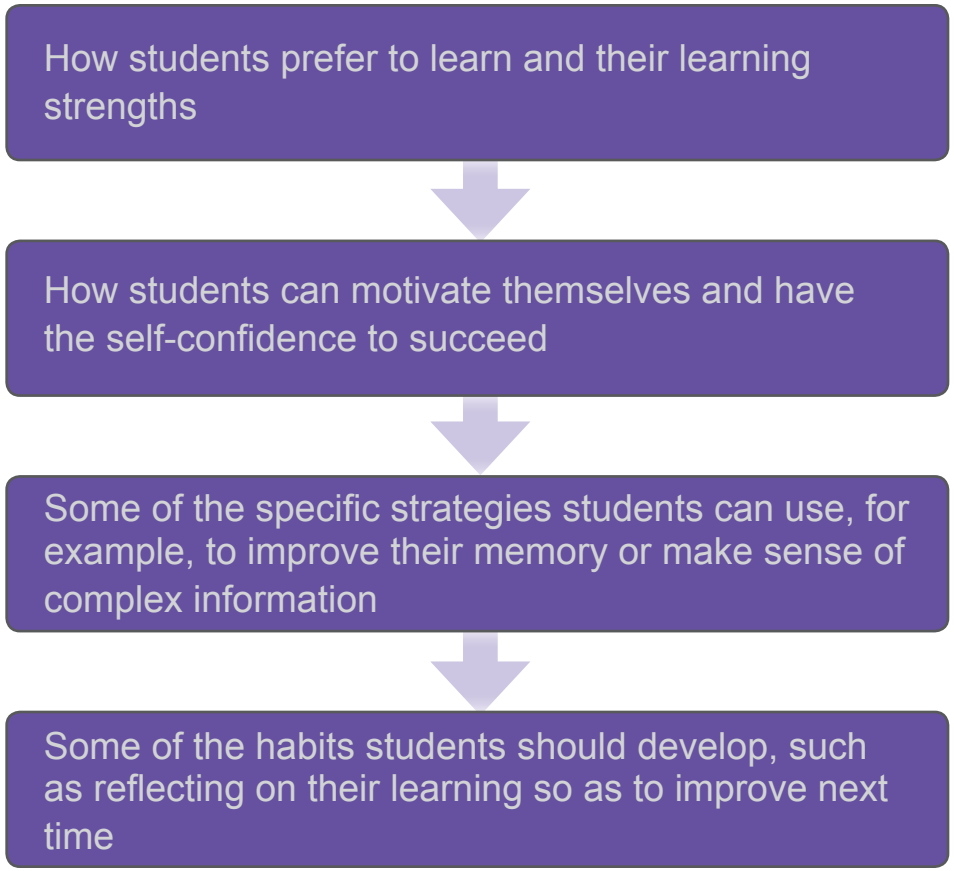


Figure 3

Importance of Learning to Learn

School is just not about grades and graduation. It is a training ground for the real world in which the students will reside and flourish. Teaching is about inspiring our students, developing their curiosity about learning, and their motivation to learn. It is about developing lifelong learning, not dependent learners. We must empower students to manage more of their learning.

Connecting Learning to Learn to the College and Career Readiness Standards

Although not addressed directly in the Cross-Disciplinary Standards, they depict learning to learn skills in the Academic Behaviors Standards of self-monitoring, study habits, perseverance, and precision/accuracy and in the Work Habits Standards, working independently and collaboratively.

Learn more about the state's alignment team's listing of performance examples for these two standards.

Strategy: Learning to Learn

- Establish your mindset that your students will be responsible for their own learning.
- Provide a classroom that is student-centered with learning facilitated by the teacher.
- Access the Study Guide Series which has a self inventory for students to discover how they learn.

STEPS teachers' recommendations for instruction:

- Provide discovery lessons that set the stage so that students want to see what is coming.
- Utilize multiple representations for your concept presentations.
- Connect to your students with relevant and real-world applications of concepts to be discussed.
- Use Socratic discussions.
- Set up situations that make them reflect and think. Use situational analysis. Why does this happen? Does it have to happen?
- Have them develop their own definitions before giving formal definitions (i.e., examples and non-examples).
- Encourage students to use their own learning style in their products, note taking, etc.
- Have students generate questions, then read the text to answer their questions.
- Have students use graphic organizers to understand word problems.
  - Have students generate pictograms from new words.
  - Have students generate questions from their notes.

Final Thoughts on Learning to Learn

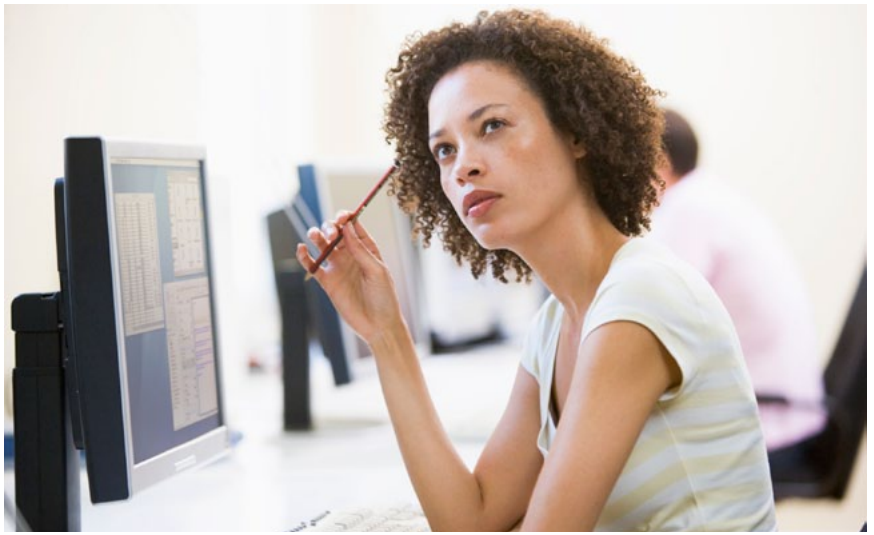
Promoting and having a mindset for learning to learn in your classroom means that you are facilitating skills so that students are motivated to learn, are able to asses their own preferred learning style, can set their own learning goals, and manage their learning. They take ownership of their own learning and can work with others to learn effectively. They are able to reflect on their work, are resilient under stress, and truly believe that they can succeed.

Critical Thinking and Problem Solving

Critical Thinking and Problem Solving

Connecting Critical Thinking and Problem Solving to the College and Career Readiness Standards

Critical thinking and problem solving are highlighted in the Cross-Disciplinary Standards as Cognitive Skills, which signifies that they are skills that cut across all curricula and are necessary for success in postsecondary and career environments. Learn more about the state's alignment team's listing of performance examples for these two standards.



Importance of Critical Thinking and Problem Solving

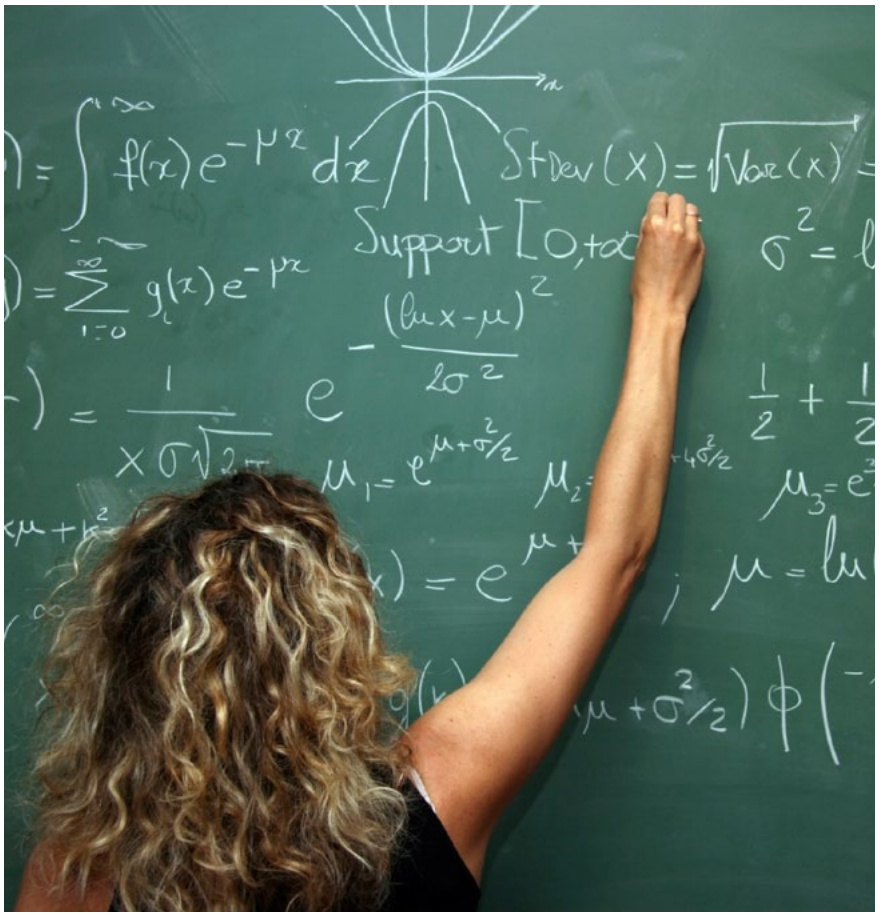
Critical thinking and problem-solving skills provide students with the ability to think for themselves, to question hypotheses, to develop alternative hypotheses, and to test those hypotheses against known facts. It allows them to effectively solve problems and make effective decisions. It provides students the ability to not only understand what they have learned or read, but also to build upon that knowledge.

Critical Thinking

According to Scriven and Paul, critical thinking "is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. …It entails the examination of those structures or elements of thought implicit in all reasoning: purpose, problem, or question-at-issue, assumptions, concepts, empirical grounding; reasoning leading to conclusions, implications and consequences, objections from alternative viewpoints, and frame of reference…" *(2007, p. 1)*.

Critical thinkers and problem-solvers are characterized by many of the following attributes:

- Inquiring (learn by questioning, exploration, and discovery)
- Challenging assumptions (reveal unstated premises)
- Determining causality (identify existing influences
- Analyzing (identify elements and relationships of elements)
- Inferring (conclusions from premises, evidence, assumptions)
- Synthesizing (combining elements to create new knowledge)
- Discovering multiple solutions (other options to meet a given criteria)
- Reflecting (assessing one's own thoughts and actions)
- Eliciting feedback (eliciting and evaluating others' responses)



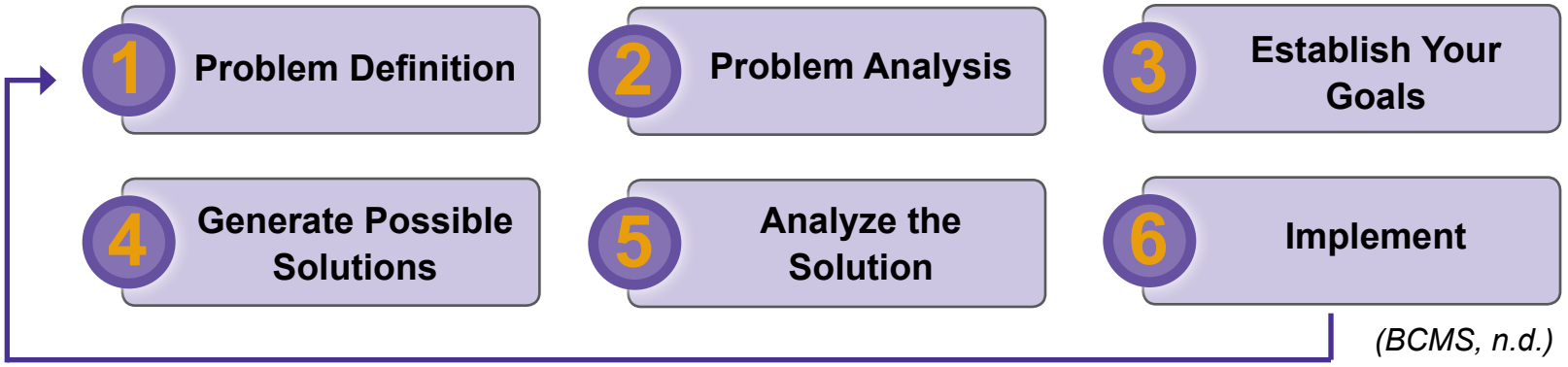
Strategy: Critical Thinking

- Use questioning techniques that require students to analyze, synthesize, and evaluate information to solve problems and make decisions (think) rather than merely to repeat information (memorize).
- Encourage students to think about their thinking.
- Provide an instructional environment that focuses on the learning process.
- Provide assessments that promote thinking rather than memorization of facts.
- Provide opportunities for students to apply what they have learned.
- For the English language learner, sentence stems can be useful in helping students frame the answers to a higher level.

Problem Solving

Problem solving is a mental process that involves discovering, analyzing, and solving problems. The ultimate goal of problem-solving is to overcome obstacles and find a solution that best resolves the issue. Problem-solving is a tool, a skill, and a process. As a tool it helps you solve a problem or achieve a goal. As a **skill** you can use it repeatedly throughout your life. And, as a **process** it involves a number of steps *(Reed, 2000)*.

The problem-solving practice as defined by BCMS Problem Solves, there are six primary steps that one must follow when problem solving as noted in Figure 4.



(BCMS, n.d.)

Figure 4

Strategy: Problem Solving

1 Step 1: Problem Definition

Before you are ready to take any steps to solve the problem, you first have to be sure that you are clear about what the problem really is. This step involves thinking about the following questions:

- How is the current situation different from what I actually want it to be?
- What do I actually want, or how do I actually want things to be?
- What is preventing me from achieving my goals, or from things being the way I want them to be?

2 Step 2: Problem Analysis

Once you have defined the problem, you need to think about it from different perspectives to ensure that you understand all the dimensions of the problem. After you have completed this step, check to make sure that your definition of the problem still fits.

The following questions can be useful to help you analyze the problem:

- How is this problem affecting me?
- How is this problem affecting other people?
- Who else is experiencing this problem?
- How do other people deal with this problem?

3 Step 3: Establish Your Goals

Once you have looked at the problem from different perspectives, you can decide what you want to achieve and establish your goals. You need to answer the very specific question: “What is my immediate goal?”

Examples:

- Improve my time management skills
- Complete assignments on time
- Improve my grades

Continued on next page...

Strategy: Problem Solving

4 Step 4: Generate Possible Solutions

During this stage the goal is to generate as many possible solutions as you can. Do not worry about whether or not they are realistic, practical, or effective. Frequently, a solution you might eliminate initially can be developed into a very effective solution with work. It can be very helpful to ask yourself what you have done in the past when faced with similar problems and how other people you know have dealt with similar situations. In addition, you can also approach friends, family, a counselor, teachers, books, or the internet, etc., to obtain ideas for solutions. Be sure to write down all the possibilities you generate so that you can approach this task systematically. Learn more about Judging the Suitability of Alternatives and Sources for Alternatives.

5 Step 5: Analyze the Solution

During this stage, you will examine each alternative and write down both the advantages and disadvantages to each. Some considerations to keep in mind include:

- Is it relevant to my situation?
- Is it realistic?
- Is it manageable?
- What are the consequences—both good and bad?
- What is the likelihood that it is going to help me reach my goal?

6 Step 6: Implementation

The last step is to implement the solution you have chosen. This step involves identification of all the steps necessary to implement it and also ongoing monitoring of the effectiveness of the solution to make sure that it actually solved the problem. During this stage of the process, ask yourself the following questions:

- How effective is the solution?
- Did it achieve what I wanted?
- What consequences (good and bad) did it have in my situation?

Continued on next page...

Strategy: Problem Solving

If the solution was successful in helping you solve your problem, then you can feel satisfied with your efforts and what you learned. If you feel dissatisfied in some way, you can either modify the solution to work better, or you can scrap it and turn to other alternative solutions, or begin the process again.

Remember that problem solving is a cycle—it involves searching for a solution to a problem that will lead to various possible solutions which then need to be evaluated. If the problem is solved, then you have found an effective solution. If the problem has not been solved, then you start the process again. (BCMS, n.d.).

"In Chemistry we call this the scientific process: Determining what is given, what is needed, where I am going, and how to get there."
(STEPS Chemistry teachers)

Final Thoughts on Critical Thinking and Problem Solving

Schools must address **key cognitive skills** of the learner to properly prepare them for their future. The CCRS Cross-Disciplinary Standards provide a framework for the learner to engage in and promote autonomy, life-long development of skills and abilities, and to live their lives with purpose.

Autonomy relates to control and trust in self. Life-long personal development is possible in all things, involving artistry, creativity, imagination, invention, with plenty of practice. Rarely is there just one way to solve a problem. Learners must begin to understand the purpose of their education and how learning can open the doors to their future careers. Their education must be purpose-driven and consistent with their larger sense of purpose. How well have schools articulated that purpose?

The content standards and Cross-Disciplinary Standards of the CCRS promote and support the cognitive skills necessary to develop the autonomy, life-long learning, and purpose-driven living that all learners should aspire to reach.

Communication

Communication as a 21st Century Skill

Communication is an essential underlying component to all areas of study, social engagement, and career success. It is the ability to articulate one's thoughts using oral, written, and nonverbal forms. To be an effective communicator, one must also be an effective listener, which allows one to decipher meaning including values, attitudes, intentions, and certainly knowledge. No longer is it just reading and writing, but technology is now an integral component. In every subject, one must be able to engage in scholarly inquiry and dialogue, be able to articulate a point of view, convey information in various forms such as graphs, tables, text, and oral presentation. Additionally, the written and/or spoken word must be composed of well-thought-out arguments based on fact. The 21st century skills include use of computer technology to communicate opinions or illustrate data, read and identify valid sources of information presented on the internet. All written communication attained from other sources needs to be documented properly being careful not to plagiarize others' work. Being able to effectively convey information to others is key to a successful career. Communication is also important as students work in groups and form teams.

Connecting Communication to the College and Career Readiness Standards

Communication is addressed in the Cross-Disciplinary Standards through the standards of Writing Across the Curriculum, the ability to write clearly and coherently, and writing in a variety of forms dependent upon the audience and Technology, using technology to communicate accurately and effectively.

In addition, communication standards are noted in the English Language Arts, Mathematics, Social Studies, and Science.

Strategy: Communication

- Students should be encouraged to make oral presentations using PowerPoint™ with embedded graphics such as photos, graphs, and tables.
- Teach variety. The type and style of communication changes depending on audience and purpose. Written documents come in many styles.
  - Have students practice reading different styles such as technical papers or lay papers and write reports in different styles such as protocol style or third person narrative when presenting results of experiments or reports on topics.
  - Have students identify the correct medium and/or format to use for a written report of varying subjects or in an oral presentation. Ask them who their audience will be and ask them to write or speak to varying audiences.
- When groups present a project, have each member of the group participate in the presentation to equally distribute the task of communicating.

Final Thoughts on Communication

21st century learners have the challenge and the luxury to utilize multiple methods of communication at their fingertips. Not only are writing and speaking still key communication skills to be successful, but also the use of technology is increasing as a key skill in writing and presenting essential information.

Using multiple methods of communication effectively can be the key to success in post secondary education as well as a career. Communication literacy comes through seeing examples and practicing multiple methods and styles until it is mastered. A student's success in a career is dependent upon communicating the right information effectively in the right context to the right listener.

Self-Monitoring & Direction Skills

Self-Monitoring & Direction Skills

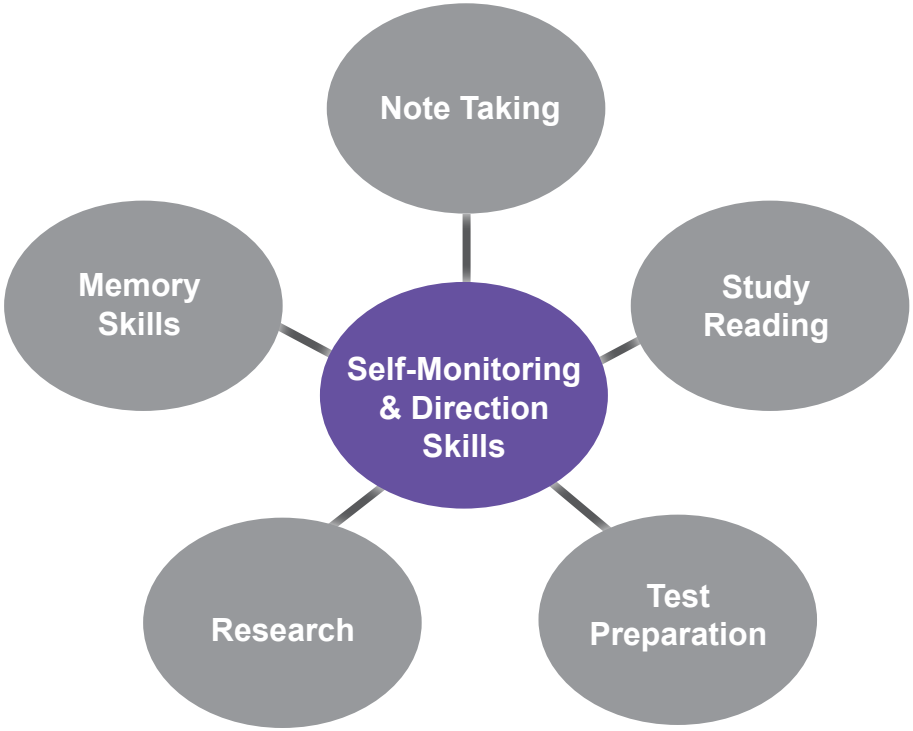
To prepare students for postsecondary and/or careers, self-monitoring and direction are skills essential for success. They are discrete techniques that can be learned, usually in a short time, and applied to all or most fields of study. This section will address five of these skills as noted in Figure 5.

Importance of Self-monitoring and Direction Skills

Many students who are most successful in traditional classrooms develop their own study skills and are able to utilize them on a regular basis. However, some struggle never recognizing that they need a strategy to enhance their success. Therefore, the teacher must explicitly teach self-monitoring and direction skills in an effort to prepare all students to be college and career ready.

Connecting Self-Monitoring & Direction Skills to the College and Career Readiness Standards

The Cross-Disciplinary Standards cluster the skills of self-monitoring and direction in the Academic Behavior Section, acquiring the ability to self-monitor, to use study habits to manage academics, and ultimately to persevere until the task is accurate and precise. In addition, study reading is addressed in the Reading Across the Curriculum Standards, the ability to analyze text critically. Research Across the Curriculum Standards testifies to necessary skills in identifying topics, exploring the topic, synthesizing information, and presenting an effective product.



Developing Skills to Use for a Lifetime

Figure 5

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Self-Monitoring & Direction Skills

Learn more about the state's alignment team's listing of performance examples in the Cross-Disciplinary Standards for:

- Research Across the Curriculum
- Academic Behaviors and Work Habits
- Reading Across the Curriculum

> *"The key to good study habits is self-assessment and active learning. Students must be able to identify what they know and what they need to know."*
> *(STEPS teachers)*

Research

Conducting educational research involves the exploration, description, explanation, or prediction of educational phenomenon using systematic data collection and analysis procedures. Researchers may be involved in multiple types of research, including qualitative, quantitative methods, or mixed methods. Primary sources are reports or articles that report an actual study describing the conceptual or theoretical framework for the study, the methodology, the findings, conclusions, and discussions. Secondary sources may report the findings of a study, but the author of the article or report are not the researchers who conducted the study. The authors make this data available through other publications or reports. Researchers use the data or information gathered and reported by other organizations or publications as secondary sources. A good researcher knows how to use both primary and secondary sources in his/her writing and to integrate them in a cohesive fashion.

Importance of Teaching Research Skills

Teaching students research skills is important because they allow the student to learn more about things, people, and events. In doing research, students are able to apply the skills that will allow them to make smart decisions for the remainder of their life.

Without research, mankind is not able to determine how anything works or how anything is made. There would be no advances in medicine, science, or anything else without it. In business, taking a risk will be a part of your students' job. Teaching them research skills will help them gain information to make informed decisions.

Strategy: Self-Monitoring & Direction Skills

Research

All educational research studies should follow a four step process. Further information about each step can be found by accessing the links in Figure 6.

Teach students to consider the following questions when beginning to think about conducting primary research:

- What do I want to discover?
- How do I plan on discovering it?
- Who am I going to talk to/observe/survey?
- How am I going to be able gain access to these groups or individuals?
- What are my biases about this topic?
- How can I make sure my biases are not reflected in my research methods?
- What do I expect to discover?

(Driscoll & Brizee, 2011)

Research: A Four Step Process

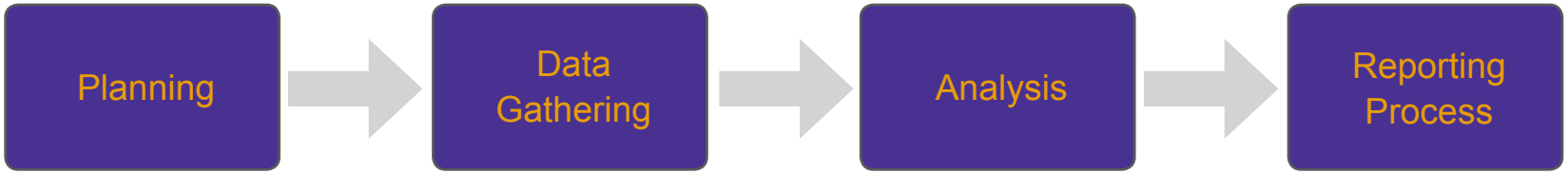


Figure 6

Memory Skills

Memory is the ability of our mind to recall information. Human memory works on two different levels: short term memory and long term memory.

According to Keely, short term memory includes what you focus on in the moment, what holds your attention. Most people can only hold about 7 items of information in short term memory at any given moment (like a phone number). To learn information so that you can retain and recall it, you must transfer it from short term to long term memory.

Long term memory includes all the information that you know and can recall. In many ways, it becomes a part of you. Once information becomes a part of your long term memory, you'll have access to it for a long time.

There are two ways to move short term memory to long term memory: rote learning and learning through understanding. Rote learning means learning through repetition, which is mechanical and requires little understanding (learning multiplication tables).

Learning through understanding involves learning and remembering by understanding the relationships among ideas and information. For example, remembering main ideas and supporting details from a lecture because you understand the concepts and relationships between ideas.

> *"We remember what we understand; we understand only what we pay attention to; we pay attention to what we want."*
> *(Edward Bolles)*

Memory Skills

Both types of memory skills are useful and often are used together. For example, in history, you need to relate facts (like dates) which you memorized by rote to your understanding of historical concepts (like the Civil War) which you remembered by understanding the information *(Keely, 1997)*.

Julie Baird shares four principles for enhancing the memory skills of your students *(Baird, 2010)*. These principles will assist the manner in which you present information as well as your expectations for your students. The next few pages provide specific examples and brain research, as well as links to learn more.

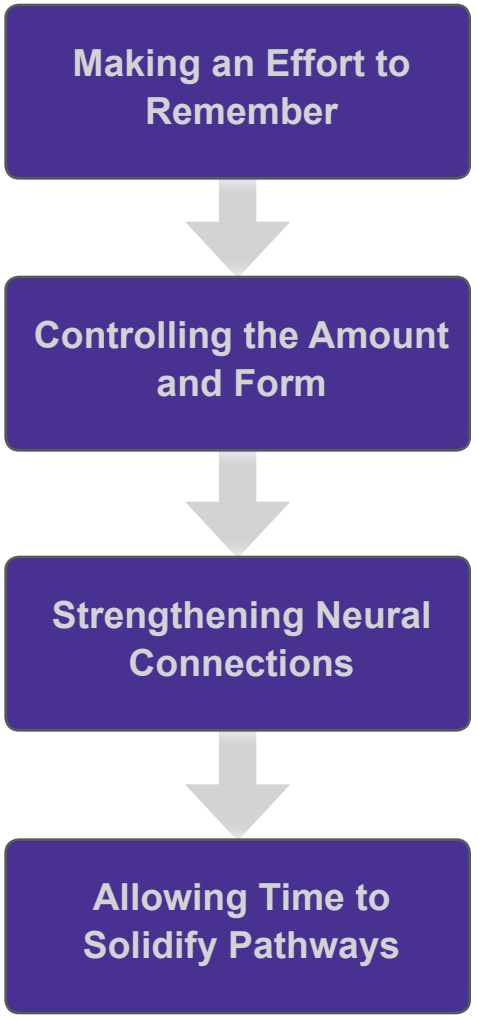


Figure 7

Strategy: Self-Monitoring & Direction Skills

Memory Skills

Making an Effort to Remember

Interest: The brain prioritizes by meaning, value, and relevance. To have meaning, you must understand what you are learning. In order to remember something thoroughly, you must be interested in it and think that it has value and relevance in your life. Learn more about Interest.

The brain prioritizes by value, meaning, and usefulness. Learn more about the Brain Research.

Intent to Remember: Your attitude has much to do with whether you remember something or not. A key factor to remembering is having a positive attitude that you get it right the first time. Attention is not the same as learning, but little learning takes place without attention. Learn more about Intent to Remember.

Learning is different from attention. But if we are not attending, we aren't learning. If the information does not get enough attention or if it is not deemed necessary for long term memory, it will be encoded in short term memory only and ultimately discarded and reclassified. Learn more about the Brain Research.

Basic Background: Your understanding of new materials depends on what you already know that you can connect it to. The more you increase your basic knowledge, the easier it is to build new knowledge on this background. Learn more about Basic Background.

It is cellular connections building on one another that activate learning, consciousness, intelligence, and memory. One must also consider bringing in references to background knowledge from different students' cultures to enhance understanding for English language learners. Learn more about the Brain Research.

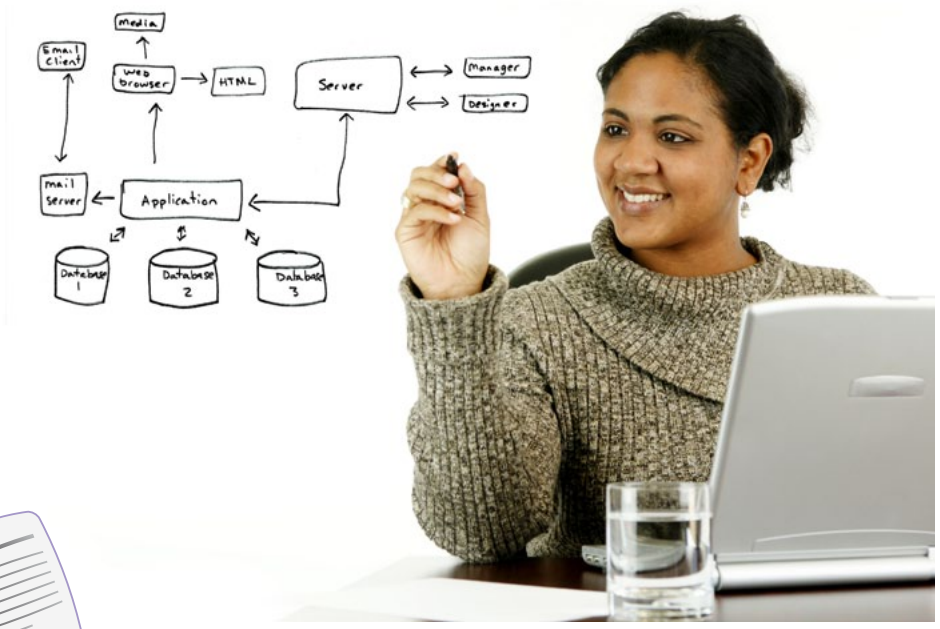
Strategy: Self-Monitoring & Direction Skills

Memory Skills

Controlling the Amount and Form

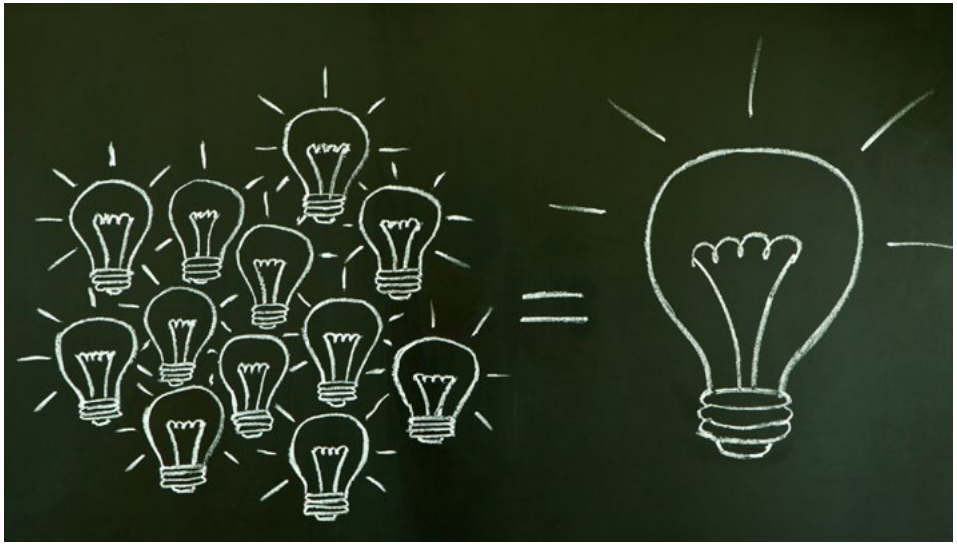
Selectivity: You must determine what is most important and select those parts to begin the process of studying and learning. Learn more about Selectivity.

Most students are drowning in information and starved for meaning. Learn more about the Brain Research.



Meaningful Organization: You can learn and remember better if you can group ideas into some sort of meaningful categories or groups. Learn more about Meaningful Organization.

To form a sharp memory of something, original information must be encoded accurately, maintained or strengthened over time, and triggered by association or cue. Learn more about the Brain Research.



Strategy: Self-Monitoring & Direction Skills

Memory Skills

Strengthening the Neural Connections

Recitation: Saying ideas aloud in your own words strengthens synaptic connections and gives you immediate feedback. The more feedback you get, the faster and more accurate your learning. Learn more about Recitation.

The more senses we use the stronger the neural trace. Learn more about the Brain Research.

Visualization: The brain's quickest and probably the longest-lasting response is to images. By making a mental picture, you use an entirely different part of the brain than you did by reading or listening. Learn more about Visualization.

The brain has an attentional bias for high contrast and novelty.

Association: Memory is increased when facts to be learned are consciously associated with something familiar to you. Memory is essentially formed by making neural connections. Begin by asking, "What is this like that I already know and understand?" Learn more about Association.

Association is central to the process of encoding and retrieval. Learn more about the Brain Research.

Strategy: Self-Monitoring & Direction Skills

Memory Skills

Allowing Time to Solidify Pathways

Consolidation: Your brain must have time for new information to establish and solidify a neural pathway. When you make a list or review your notes right after class, you are using the principle of consolidation. Learn more about Consolidation.

Processing time is necessary to build the inner wiring necessary for connectivity and recall. Learn more about the Brain Research.

Distributed Practice: A series of shorter study sessions distributed over several days is preferable to fewer but longer study sessions. Learn more about Distributed Practice.

Short sessions, more often, create growth of dendrites and connections exponentially. Learn more about the Brain Research. *(Baird, 2010)*.

"We find peer tutoring (breaking down into small groups) is a great way to solidify pathways. Hearing the same information but in a different way can help solidify pathways."
(STEPS teachers)

Note Taking

Note taking is a postsecondary student expectation and an important strategy for college readiness. There are many types and systems for note taking but they all focus on developing for the student a systematic method for depicting the main ideas of lectures and texts, utilizing symbols and abbreviations, documenting questions, and summarizing presented material. There are numerous note taking systems.

Importance of Note Taking

For your students to be college and career ready, their success begins with being organized and ready to learn during a lecture as well as when they are reading materials. Note taking helps them to be focused in class, organize the presented content, and provides a study guide.

The amount of information delivered by the professor and from extra readings demand that the student employ a workable, practiced note taking system.

This skill is also important for careers as any meeting presents a wealth of information that requires one to determine salient points.

> *"Teachers must be very literal and model exactly what you want students to gain and apply from the note taking experience. Always have the student reflect on and summarize recorded notes. For biology, illustrations are a part of the notes."*
>
> *(STEPS teachers)*

Strategy: Self-Monitoring & Direction Skills

Note Taking

There are any number of resources for note taking strategies and systems. The teacher must choose a system and teach the strategy specifically and set the student expectation. The primary purpose, however, is to have the student as the active learner in the note taking process and have a system that requires the student to reflect upon the notes.

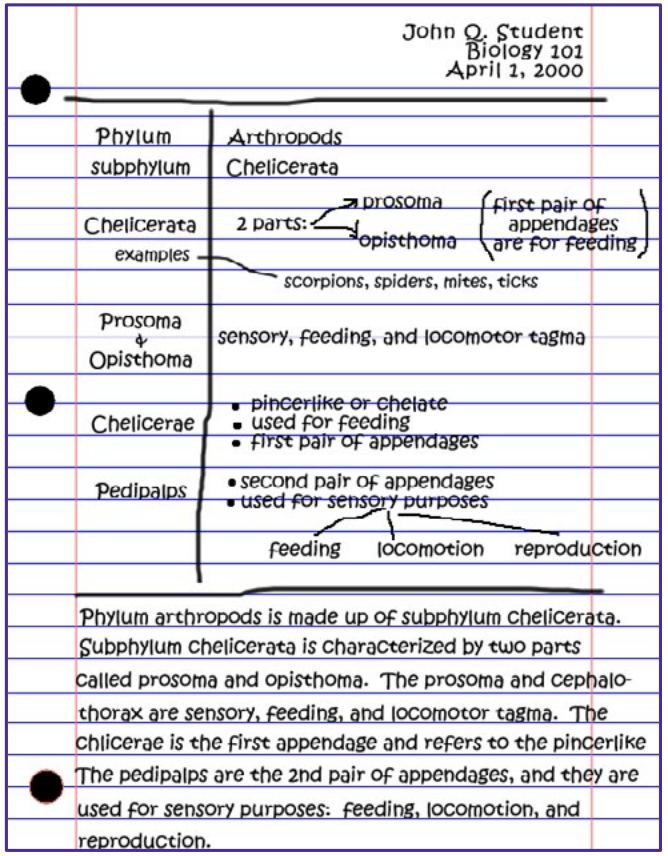
Cornell Note Taking is a proven method. It provides a systematic format for organizing and condensing your notes. It teaches the student to divide the paper format into three sections, how to document the heading, how to write notes, how to review and clarify notes, how to summarize your notes, and ultimately how to study your notes.

Figure 16 represents an example for a Biology class from the Learning ToolBox. Download a template example for Cornell Note Taking.

"Our #1 recommendation, show them how.

- Teach the student to list all issues that he/she does not understand in the left hand margin of any note taking system. This will signal them to seek counsel or further clarification.
- Show them how to use their notes to study."

(*STEPS teachers*)



(Learning Tool Box, n.d.)

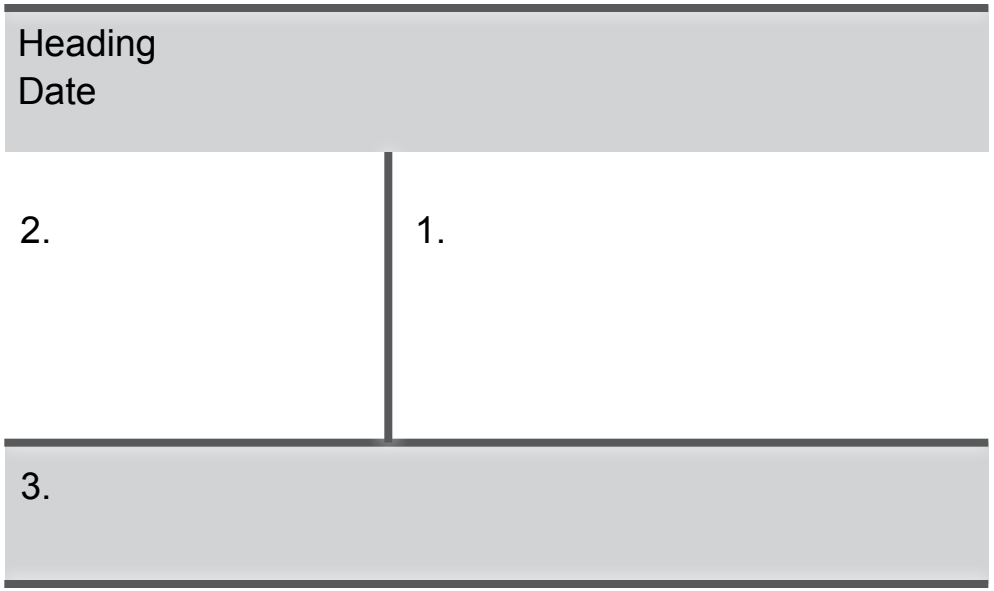
Figure 8

Strategy: Self-Monitoring & Direction Skills

Note Taking

Study Guides and Strategies Series provides a 5 R system for note taking. Figure 9 provides the page set up for this system.

Note Taking System
Study Guides and Strategies Series



(Study Guides and Strategies Series, n.d.)
Figure 9

1. **Record:** Teach them to identify the main points capturing the main ideas. Encourage them to use outlines or concept maps.

2. **Reduce:** Teach them a discipline that after class they are to summarize by identifying the key words, phrases, or questions. They can link to information from their textbook, websites, or other sources that help them understand or study the material.

3. **Recite:** You teach them to talk-aloud so they review from memory what they have learned using the left-hand margin's key words and questions, and also talk through, or illustrate definitions, concepts, etc.
   Reflect: Teach them to relate the information to what they knew before.
   Review: Teach them to review their notes.

Study Reading

Study Reading is a highly recommended study method which was developed by Francis Robinson. There are five basic steps as noted in Figure 10. These steps are based on the premise that understanding and retention require reading and study.

Importance of Study Reading

In high school, the student typically reads 1-10 pages and discusses the information. In college, the student is expected to read 1-10 chapters; the amount of information required to be successful in the postsecondary environments requires a process for the student to deal successfully with the amount of information required. Some students develop these skills without direct instruction, however, many do not.

Study reading is one technique that teachers can teach their students which includes five phases: surveying the text, questioning, reading, reciting, and reviewing.

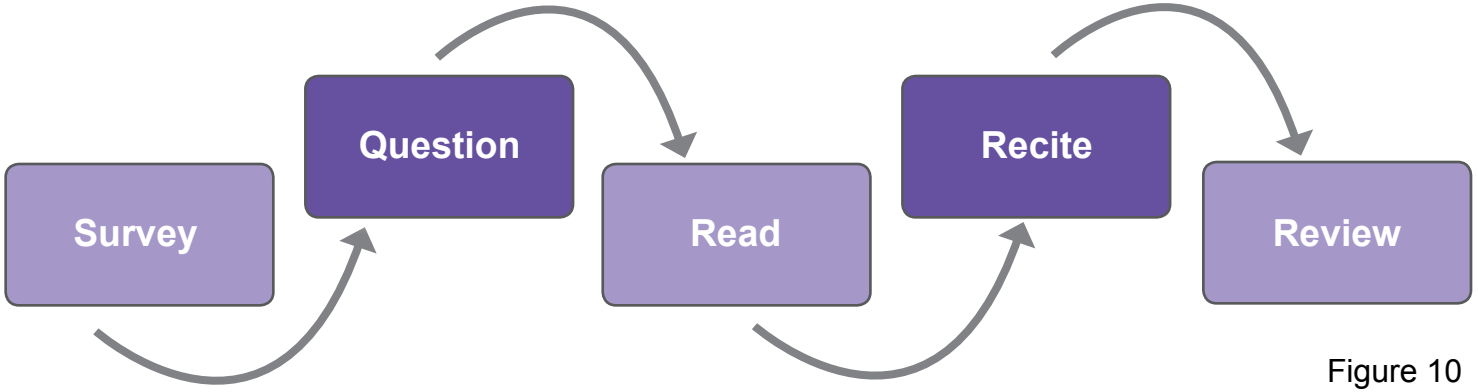


Figure 10

Strategy: Self-Monitoring & Direction Skills

Study Reading

You can teach students to study while reading by teaching them the following five steps:

1

Steps in Surveying a Chapter

Surveying or previewing a chapter entails several processes, including reading the title, the objectives, and introductory paragraph(s). Then skim the heading, sub-headings; read the topic sentence (most often the first sentence in each paragraph). Next, glance at any pictures, graphs, or diagrams. Carefully read the summary or highlights and questions which will give you an overview of the important information within the chapter. Remember that even if time does not permit you to complete all of these strategies, never eliminate the reading of the summary or highlights.

2

Questions (Opened or Closed)

To stimulate your intellectual curiosity you need to write your own questions and/or reread the questions listed at the end of the chapter. Questions can be easily formed by using Who, What, Where, When, How, and Why with a heading or sub-heading. The open questions (What, How, and Why?) call for extended answers, whereas the closed questions (Who, Where, and When?) call for briefer answers. By forming your own questions, you will focus on the material being read, improve your concentration, and provide a purpose for your reading. In addition, you may want to reread the chapter questions to determine what the author considers important. Regardless of the method, you will become a more active reader since you will be reading to answer the questions you posed or read.

(Oakton Community College Learning Center, n.d.)

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Strategy: Self-Monitoring & Direction Skills

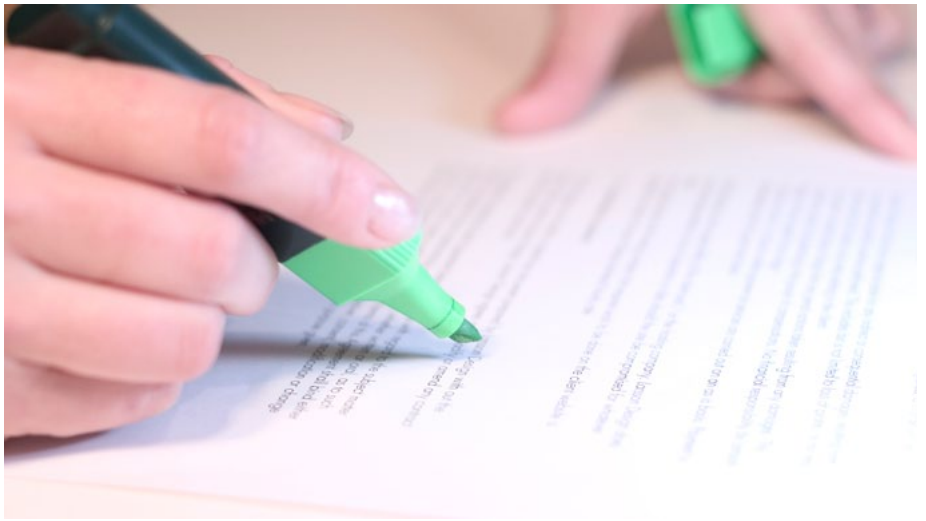
Study Reading

3 Read (Underlining - Margin Notes)

It is important to understand that study reading is not simply a passive activity, for you need to read actively to improve your understanding and retention. Reading to predict and find answers to questions will help you to delineate important concepts and ideas. Some people prefer to underline or highlight while others take margin notes or separate notes. If you decide to underline or highlight, do so after you have read the section so that you can more accurately select the main concepts. Also, do not underline too much. If you underline or highlight more than 20 to 25 percent of the material, you will be unable to differentiate between important and unimportant material, and the time spent underlining will have been wasted. Remember to underline the key words or phrases, not the entire sentence, unless necessary. Margin notes are especially helpful in conjunction with underlining. Not only do they provide another means of recognizing important material, but they also call for critical thinking. If you are a visual or tactile/kinesthetic learner, you will find this method is invaluable.

4 Recite (3 Ways to Recite)

Depending on your learning style(s), you can recite in various ways: orally, mentally, or in a written form. This activity should be done after reading each section or as often as needed. Students who are auditory learners might want to tape record their recitations to review later for an exam. Students who are visual or tactile/kinesthetic learners will find it helpful to outline, take notes, or make concept flash cards. Study skills specialists recommend that nearly half of your study-reading time should be spent in this step.



(Oakton Community College Learning Center, n.d.)

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Strategy: Self-Monitoring & Direction Skills

Study Reading

5 Review (Review Methods)

The final step, Review, is the most important one for retention of material, yet one of the most readily eliminated by students. Frequently, students are anxious to do other things and simply close their text at the completion of reading. Yet, ten minutes of review will dramatically improve the normal curve of forgetting.

Again, there are myriad ways of completing this step. Some students answer questions, review notes or underline material, and write a summary of the main points, while others review aloud. Students who are highly visual may choose to make a map or chart of the material. Basically, there is no single method that is best for everyone, for successful reviewing depends on utilizing the strategies which work best for you.

(Oakton Community College Learning Center, n.d.)

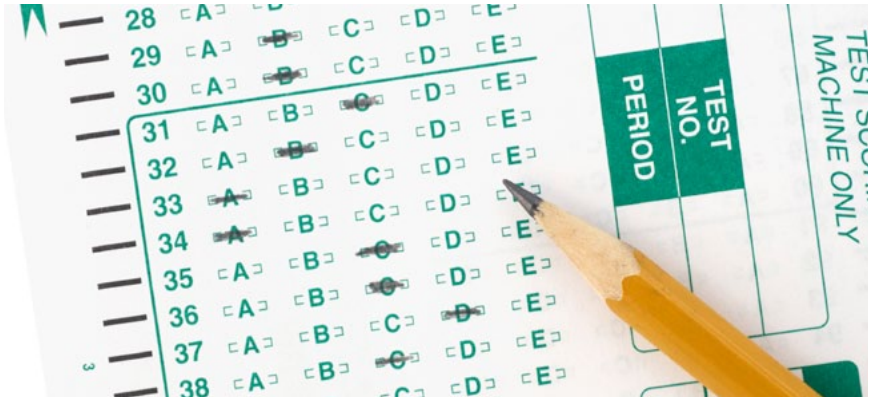
"Review each day's lesson at the end of the lesson, taking small amounts of information rather than trying to study it all in one sitting."
(STEPS teachers)

Test Preparation

Test preparation refers to any learning tools, courses, tutoring, and/or other materials that assists one to be more successful on a test.

Not only is this skill relevant for college readiness, but careers as well, in that one pursues the same steps in preparing for a business presentation.

Importance of Test Preparation
The teacher plays a critical role in introducing a variety of tools for students to learn so that they ultimately can determine which tools best fit their learning styles and they learn to implement them independently. Before the student enters the postsecondary environment, he/she must have command of how to prepare for tests; without such, they will struggle.



Strategy: Self-Monitoring & Direction Skills

Test Preparation - Organizing for Test Taking

Have your students learn some of these organizational tips developed by Study Guides and Strategies:

- Begin reviewing early. This will give your brain time to get comfortable with the information.
- Conduct short daily review sessions. You can ease into a more intense review session prior to major exams.
- Read text assignments before lectures. This will help you identify concepts that the teacher considers important and that are already somewhat familiar.
- Review notes immediately after lectures. This will help you identify information that you do not understand while the lecture is still fresh in your memory—and other students' memories as well. When you review immediately, you'll have time to clarify information with other students.
- Review with a group. This will enable you to cover important material that you may overlook on your own.
- Conduct a major review early enough to allow for a discussion with your teacher prior to the exam if necessary.
- Break up the study tasks into manageable chunks, especially during major reviews prior to exams. Studying three hours in the morning and three in the evening will be more effective than studying for a six-hour stretch. Studying while you are mentally fatigued is usually a waste of time.
- Study the most difficult material when you are alert.

Test Preparation - Reviewing

In reviewing the material, the student should be taught to use one or more of the following review tools:

- Create study checklists. Have them identify all of the material that they will be tested on—list notes, formulas, ideas, and text assignments they are accountable for. This checklist will enable the student to break studying into organized, manageable chunks, which should allow for a comprehensive review plan with minimal anxiety.

- Create summary notes and "maps." Have them briefly map out the important ideas of the material and the relationships of these ideas. Summary notes should display lists and hierarchies of ideas. Creativity and a visual framework, such as in Figure 11, will help the student recall these ideas.

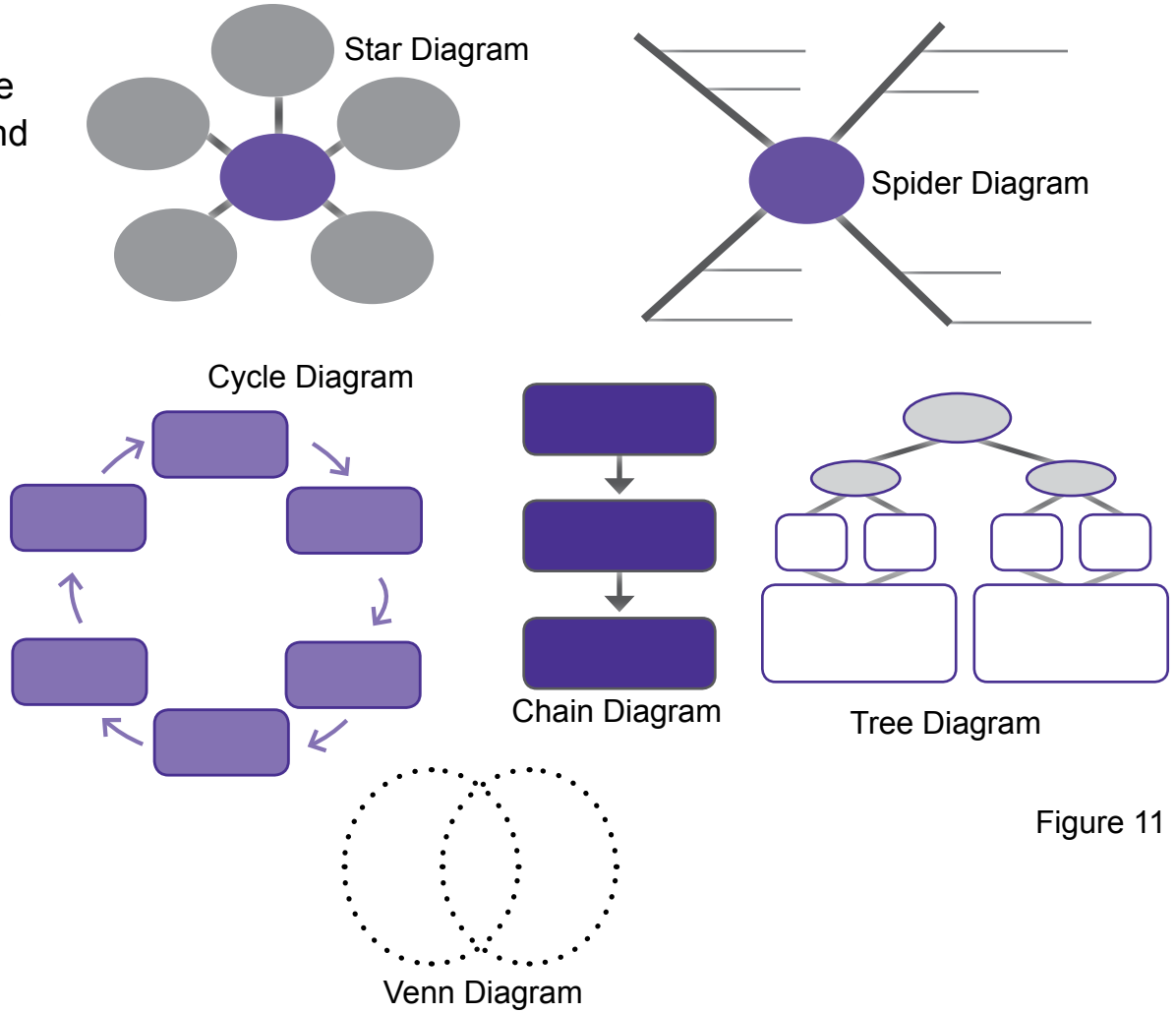


Figure 11

Continued on next page...

Strategy: Self-Monitoring & Direction Skills

Test Preparation - Reviewing

In reviewing the material, the student should be taught to use one or more of the following review tools:

- Record your notes. Have them record important information. This will enable them to study while walking or relaxing in a nonacademic environment.

- Create flashcards. Have them create flashcards for definitions, formulas, or lists that need to be memorized. Put topics on one side of the card, answers on the other. Flashcards will enable them to test their ability to not only recognize important information, but also their ability to retrieve information from scratch.

(Study Guides and Strategies, n.d.)

Final Thoughts on Self-Monitoring & Direction Skills

Those learners who self-monitor and who are self-directed set their own goals and incorporate strategies to assist with the learning.

These learners are both able and willing to take responsibility for their learning and productivity. They exercise skills in project management, goal-setting, self-evaluation, time management, and use of educational resources.

Collaboration

Collaboration as a 21st Century Skill

Collaboration is the act of working with another or others on a joint project. The classrooms of yesterday lend themselves to just that; skills learned for yesterday. College classrooms give students the opportunity to work with classmates and seek information from groups of experts in their field of study, ultimately empowering themselves for today's challenges.

Teachers rely on students' prior knowledge in many cases. Through collaboration, a sharing between and among students can provide an open dialogue that the instructor can hear and respond to. The instructor serves as a mediator.

Even though the teacher carries the knowledge about the subject material and the pedagogy, he/she can build upon the students' abilities making them feel as the center of "instruction" even though the "work" is being primarily generated by the students. The teacher often plays the role of the facilitator in order for students to take the lead. This in a sense is a difficult role to play for many teachers who are at ease with being the disseminator of all information.

The students need to be empowered. Their struggle for ownership of the content and skills is earned through their collaboration. The environment of the collaborative classroom enables the students to assess what they know and ultimately do not know. Learn more about collaboration.

Collaboration as a 21st Century Skill

Importance of Teaching Collaboration Skills
Success in today's world demands the ability to collaborate with others in order to take the appropriate actions. Collaboration in the classroom allows the student to be recognized. Having the student be responsible for sharing ideas, strategies, experiences, and knowledge with others gives the student a sense of importance and belonging. In the college setting, students are allowed if not expected to collaborate with others in the classroom and even many times outside the classroom. Multiple strategies are necessary to solve many problems and situations. Students can always broaden their own viewpoints through working with others. Hearing other viewpoints from their group members can help them form a more open mind. Being open minded will allow this broadening to occur through conflict, challenge, compromise, and perseverance.

Connecting Collaboration to the College and Career Readiness Standards
The Cross-Disciplinary Standards directly specify working collaboratively as a pertinent skill for postsecondary, which cuts across all curriculum and career readiness in the Work Habits Standards. Learn more about the state's alignment team's listing of performance examples for this standard.

> *"In a collaborative classroom, assessment means more than just assigning a grade. It means evaluating whether one has learned what one intended to learn, the effectiveness of learning strategies, the quality of products and decisions about which products reflect one's best work, the usefulness of the materials used in a task, and whether future learning is needed and how that learning might be realized."*
>
> *(Tinzman, Jones, Fennimore, Bakker, Fine, Pierce, 1990)*

Strategy: Collaboration

Multiple strategies are necessary to solve many problems and situations.

- Serve as a model. Collaboration just doesn't happen. Many times the instructor must show step by step procedures for solving a problem or deliver important concepts that underlie the situation at hand.
- Organize students into heterogeneous groups with roles such as Team Leader, Encourager, Re-teller, Recorder, Spokesperson, etc.

- Establish rules and practice them. Set rules so that all students participate. The teacher will need to set expectations for valuing others' comments, and arguing against (or for) ideas rather than people.
- Create learning tasks that encourage diversity, but which aim at high standards of performance for all students. These tasks involve students in high-level thought processes such as decision-making and problem solving that are best accomplished in collaboration. These tasks enable students to make connections to real-world objects, events, and situations in their own and an expanded world, and tap their diverse perspectives and experiences. Learning tasks foster students' confidence and at the same time, are appropriately challenging *(Tinzman, Jones, Fennimore, Bakker, Fine, Pierce, 1990)*.

Continued on next page...

Strategy: Collaboration

Multiple strategies are necessary to solve many problems and situations.

- Expect students to take responsibility for monitoring, adjusting, self-questioning, and questioning each other. Such self-regulating activities are critical for students to learn today.
- Expect dialogue. Students should discuss their approaches to problem solving, elaborate on their reasoning, and defend their work.
- Avoid skill and drill as the primary mode of instruction. Model high level questioning and conversation when the class is involved in group discussions.
- Guide students as they engage in learning and as they verbalize their own knowledge.

Final Thoughts on Collaboration

Ultimately, our students will enter into the workforce where problem solving at some level will be necessary. They will share their ideas with others that agree, disagree, or have no opinion at all. We need to empower our students with the essential tools and give them opportunities for collaboration in the classroom. These experiences will transfer into their everyday dealings in their career.

Closing Remarks

Our students are our future and the future holds many unknowns. One thing is certain; our students will have to be empowered in order to succeed in college and their career. Mastering the 21st Century Skills are a necessity.

As teachers, we must expose our students to each of these skills and hold them accountable for utilizing them. As stated in this module, the classroom is a practice round for what the real world plans on throwing at our students. We need to make sure that they all have the ability to flourish.

The STEPS team acknowledges your dedication to our Texas students and confidently joins you as we prepare our students to enter a globally competitive, highly interactive job market upon graduation.

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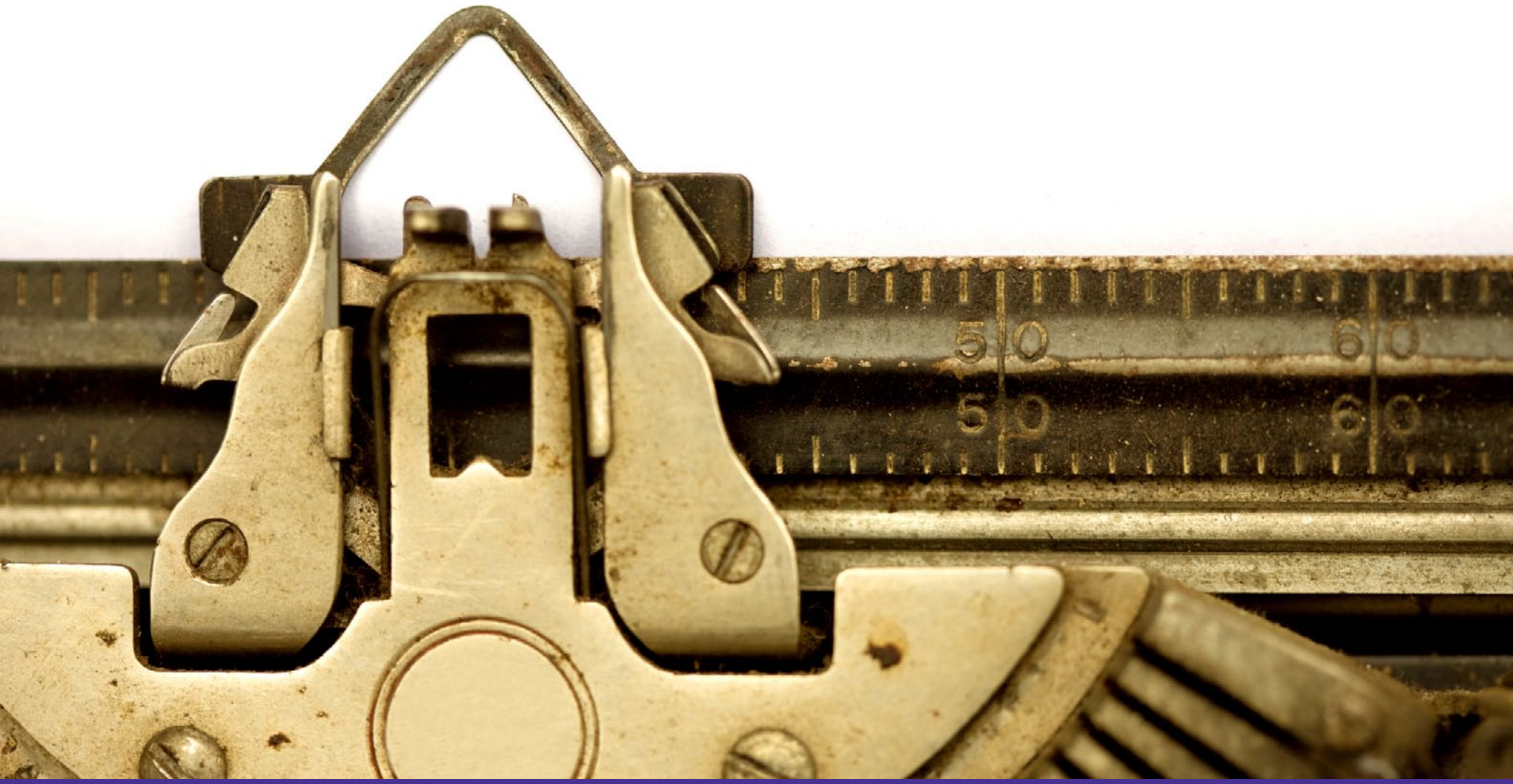
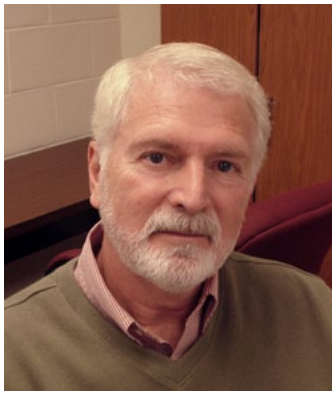


About the Authors

About the Authors



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Dr. Sally Haas received her Ph.D. in Mathematics Education from Texas A&M University and her Master's of Science in Mathematics for Secondary Teaching from Stephen F. Austin University. She has been a mathematics instructor for 15 years at Angelina College and two years at Blinn College. Before her career in higher education, she taught mathematics for seven years in the high school. Currently she serves as NASA Community College Aerospace Scholars Mentor and as senior personnel for the T4 (Talented Teachers in Training for Texas, a Noyce Grant awarded to SFASU mathematics Department) Program for STEM majors. She is also involved with local public schools and recently held an annual Pen Pal Mathematics Activity Day at Angelina College for the thirteenth year.

The findings related and views expressed in this report are solely those of the authors and do not necessarily represent the views of, and should not be attributed to, the Texas Higher Education Coordinating Board.

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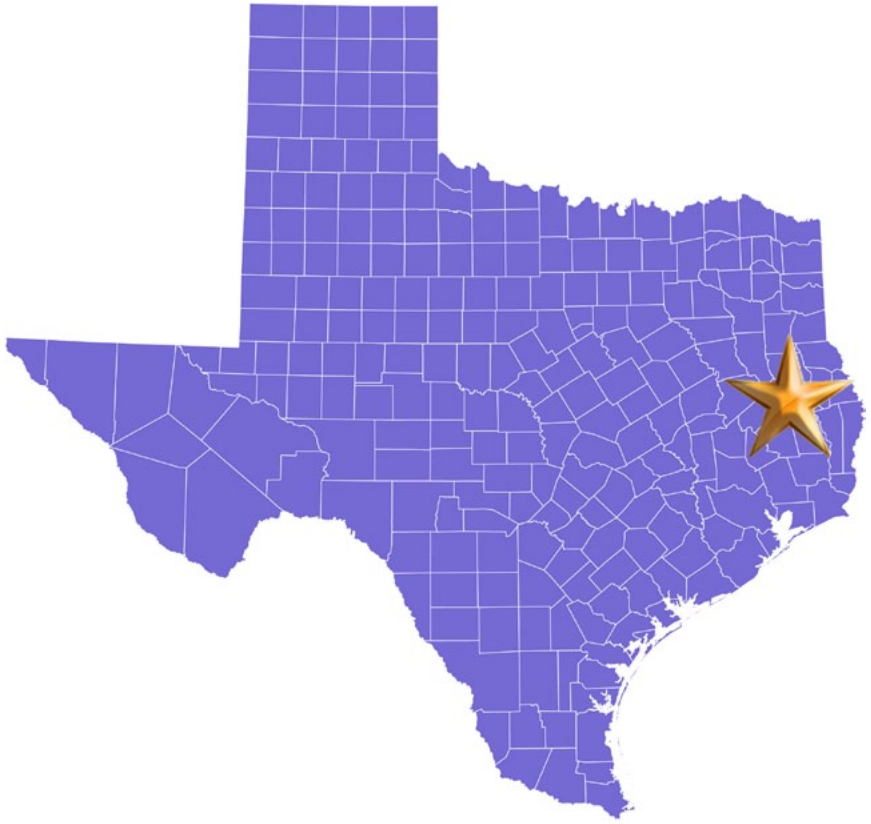

Supporting Information

Example of Cornell Note Taking Template

Return

Cue Column 2 ½”	Note Taking Column 6”
	1. **Record:** During the lecture, use the note taking column to record the lecture using telegraphic sentences. 2. **Questions:** As soon after class as possible, formulate questions based on the notes in the right-hand column. Writing questions helps to clarify meanings, reveal relationships, establish continuity, and strengthen memory. Also, the writing of questions sets up a perfect stage for exam-studying later. 3. **Recite:** Cover the note taking column with a sheet of paper. Then, looking at the questions or cue-words in the question and cue column only, say aloud, in your own words, the answers to the questions, facts, or ideas indicated by the cue-words. 4. **Reflect:** Reflect on the material by asking yourself questions, for example: “What’s the significance of these facts? What principle are they based on? How can I apply them? How do they fit in with what I already know? What’s beyond them? 5. **Review:** Spend at least ten minutes every week reviewing all your previous notes. If you do, you’ll retain a great deal for current use, as well as, for the exam.
Summary After class, use this space at the bottom of each page to summarize the notes on that page.	

(Cornell Notes, n.d.)

Planning

Return

STEP 1: Identifying the problem
The literature review will help you gain an understanding of the current state of knowledge pertaining to your research idea. It will inform you if the research problem or topic has already been explored (and if a revision or replication is needed), how to design your study, what data collection methods to use, and help make sense of the findings of your study once data analysis is complete.

STEP 2: Review prior research
The literature review will help you gain an understanding of the current state of knowledge pertaining to your research idea. It will inform you if the research problem or topic has already been explored (and if a revision or replication is needed), how to design your study, what data collection methods to use, and help make sense of the findings of your study once data analysis is complete.

STEP 3: Determine the purpose, research questions, or hypotheses
Identifying a clear purpose helps determine how the research should be conducted, what research design you will use, and the research question(s) or hypothesis(es) of your study. Four general purposes for conducting educational research are to explore, describe, predict, or explain.

STEP 4: Consider research implications
Implications are the practical ways your research will affect the field of education. These are the underlying goals, the rationales for, or the importance of your study. Implications are linked to your research problem or topic, research purpose, and research question(s) or hypothesis(es).

STEP 5: Construct a research proposal
The research proposal is a detailed description of how the study will be conducted that includes the title and researchers of the study, statement of the research problem and research purpose, review of relevant literature, research question(s) or hypothesis(es), what information or variables are to be gathered, the participants of the study and potential benefits or risks, the design and procedure for gathering data, what data collection method(s) will be used, and how the data will be analyzed.

(University of Texas, 2011)

Data Gathering

Return

STEP 6: Data Gathering
Data gathering focuses on information acquisition that will attempt to answer your research questions or support your hypotheses.

Data gathering includes consideration about what variables to investigate, the unit of analysis or participants of the study (population and sample), human subject protections, procedures used for selecting participants, the methods and procedures used for data collection, and any reliability or validity of collection methods.

(University of Texas, 2011)

Analysis

Return

STEP 7: Analyze Data

Data or statistical analysis will depend on whether you collected quantitative data, qualitative data , or both. For quantitative data, there are a variety of statistical analysis tools, graphing with error bars, standard deviations, you can use to identify statistical relationships between variables. For qualitative data, data analysis generally involves holistically identifying patterns, categories, and themes.

STEP 8: Determine Findings

Determine the findings from your data analyses. For quantitative data, you want to determine statistical information and general findings. For qualitative data, you are primary more interested in detailed and specific findings. If you are using a mixed approach, which we strongly recommend, make sure to triangulate your findings or describe how the findings supplement each other and help explain a more complete picture.

(University of Texas, 2011)

Reporting

Return

STEP 9: Report conclusions, implications, and limitations

Conclusions are statements that interpret and evaluate the results found from the study. Make sure to give primary emphasis to the results that relate to the hypotheses or research questions of your study.

Factors to consider when reporting conclusions, or data dissemination, include tailoring report content for the audience, explaining the purpose of the study, integrating your findings with the results from prior research, and how the findings relate to your research questions and hypotheses.

Make sure to discuss what practical or theoretical implications can be drawn for your study, any major shortcomings or limitations of your research, and directions or suggestions for future research.

(University of Texas, 2011)

Strategies for Generating Alternatives

Return

Some criteria that are often used in judging the suitability of alternatives include:

1. Cost – can we afford it; will it be cost-effective?
2. Reliability – does it have proven success, or is it subject to failures?
3. Stability – will it still work if conditions change?
4. Invulnerability – will it work if one of its component parts fails?
5. Flexibility – can it accomplish more than one thing?
6. Riskiness – is there a high chance of all or nothing?
7. Communicability – is it easy to understand?
8. Merit – does it address the problem?
9. Simplicity – is it easy to implement?
10. Compatibility – is it congruent with existing norms and procedures?
11. Reversibility – can we return to our prior state if it fails?

(BCMS, n.d.)

Sources for Alternatives

1. The status quo or no action alternative. This means that current efforts will continue at the same level. It is important to consider how effective any different alternative will be at changing the status quo.
   A baseline analysis: identifies clear trade-offs with the present; clarifies project objectives; underlines whether there is a need for action or not; provides linkages to existing efforts; identifies problems likely to emerge; and confirms that no optimum solution exists.
2. Experiences of others with similar problems, from reported research findings, experts, laws, public opinion polls, new technology, etc.
3. Re-define the problem from others' points of view, including opponents of any change.
4. Consider the ideal, then apply political, economic, and other constraints
5. Start from generic, to modified, to custom-made alternatives.
6. Quick surveys by telephone, fax, or e-mail, of peers, old MPA classmates, people in the policy issue network, public meetings or hearings, content analysis of editorials, letters to the editor, etc.
7. Literature review of professional and academic journals, government reports, collected proceedings from conferences, on-line services (lexis-nexus, first search, article first etc.).
8. Case studies of real-world experiences: why was the alternative adopted, what were the circumstances, what other alternatives were considered and discarded, how did it eventually work out, what modifications were made after implementation.
9. Passive collection and classification: keep a folder for collecting interesting policy solutions on a regular basis, even if no problem exists at the moment, from clients, superiors, advocates, media, interest groups, etc. Then refer to the folder in emergencies.
10. Develop typologies: identify all the types of persons likely to be affected by any policy alternative, and what the probable reaction of each group would be to each type of alternative suggested; then develop alternatives that can overcome the objections of most of the groups.

Continued on next page...

Sources for Alternatives

Return

11. Use analogies: ‘new’ problems are really just like other ‘old’ problems.
    Personal Analogy--pretend to be someone affected by this problem, identify with the problem to see what types of policy alternatives suggest themselves;
    Direct Analogy--look at solutions to other problems to see if they can be applied to this one;
    Symbolic Analogy--imagine the most aesthetically satisfying solutions rather than merely technologically sound ones;
    Fantasy Analogy--image the ideal solution, and try to preserve as much of it as possible when working backwards through real-world constraints.
12. Brainstorming--can be oral, written, or electronic. Brainstorming has two phases, first a pure idea-generation phase, where no judgments are made about any ideas; and second, an evaluation and ranking phase, to help arrive at concrete solutions.
13. Feasible Manipulation--takes existing policy activities and develops alternatives based on limited, moderate, or wide manipulation of the range of possible activities.
14. Modify existing solutions:
    Magnify--do more, more often, larger, longer, exaggerate, add new components, new resources;
    Minify--do less, less often, smaller, shorter, omit, remove, split apart, under use, fewer resources;
    Substitute--switch components, apply in different order, use different materials, try a different location or different sponsor;
    Combine--blend approaches, combine units, combine purposes, combine sponsors;
    Re-arrange--reverse, invert, change sequence, speed up, slow down, randomize;
    Location--use single or multiple locations, node versus scattered, temporary versus permanent;
    Timing--accelerate, lag, stagger, run concurrently, shorter span, longer span, time sharing.

(BCMS, n.d.)

Cross-Disciplinary Standards

Return

I. Key Cognitive Skills	
D. Academic Behaviors	E. Work Habits
1. Self monitor learning needs. a. Ask questions to check for understanding or to clarify information. b. Use a systematic method for recording, storing, and organizing materials and resources; avoid haphazard or messy accumulation of information. **2. Use study habits necessary to manage academic pursuits and requirements.** a. Manage time effectively to complete tasks on time. b. Demonstrate accurate note-taking. c. Use the appropriate level of detail necessary to complete an assigned task. d. Balance academic and non-academic activities to successfully participate in both. **3. Strive for accuracy and precision.** a. Collect and report experimental data carefully and correctly. b. Produce charts, graphs, and diagrams accurately, including scale, labeling, units, and organization. c. Eliminate irrelevant information from an assignment. **4. Persevere to complete and master tasks.** a. Persevere until a task is completed by working even when faced with uncertainty or open-ended assignments. b. Seek assistance when needed to complete the assignment. c. Recognize when a task is completed. *(EPIC, 2008, p. a60)*	**1. Work independently.** a. Plan a project, establish its parameters, and complete it with minimal supervision, seeking assistance accordingly. b. Follow directions or procedures independently. c. Complete assignments outside the classroom setting in a timely manner. **2. Work collaboratively.** a. Work collaboratively with students from various cultural and ethnic backgrounds. b. Distinguish between situations where collaborative work is appropriate and where it is not. c. Work in small groups to investigate a problem or conduct an experiment. *(EPIC, 2008, p. a60)*

Cross-Disciplinary Standards

I. Key Cognitive Skills	
A. Intellectual Curiosity	B. Reasoning
1. Engage in scholarly inquiry and dialogue. a. Identify what is known, not known, and what one wants to know in a problem. b. Conduct investigations and observations. c. Cite examples or illustrations in which a clear-cut answer cannot be reached. **2. Accept constructive criticism and revise personal views when valid evidence warrants.** a. Articulate a point of view and provide valid evidence to support findings. b. Demonstrate willingness to take intellectual risks by investigating novel, controversial, or unpopular opinions or conclusions. c. Examine alternative points of view, taking different roles to defend, oppose, and remain neutral on issues. d. Recognize conflicting information or unexplained phenomena. *(EPIC, 2008, p. 59)*	**1. Consider arguments and conclusions of self and others.** a. Know and apply logic to analyze patterns and descriptions and to evaluate conclusions. b. Cite valid examples or illustrations that support the conclusions. c. Question whether the claims and conclusions of self and others are supported by evidence. d. Identify counter examples to disprove a conclusion. **2. Construct well-reasoned arguments to explain phenomena, validate conjectures, or support positions.** a. Participate in a debate that is based on facts and has a logical structure. b. Construct a visual presentation, including hypothesis, data, results, and conclusion. c. Write a paper that addresses counterarguments to advocated positions. d. Recognize and apply techniques of statistical or probabilistic analysis to judge reliability of information. e. Organize an argument separating fact from opinion. **3. Gather evidence to support arguments, findings, or lines of reasoning.** a. Use different kinds of data (e.g., case studies, statistics, surveys, documents) to support an argument. b. Evaluate evidence in terms of quality and quantity. c. Describe limitations of data collection methods. **4. Support or modify claims based on the results of an inquiry.** a. Refine claims and adjust a position in response to inquiry. b. Review and check strategies and calculations, using alternative approaches when possible. *(EPIC, 2008, p. 59)*

Continued on next page...

Cross-Disciplinary Standards

Return

I. Key Cognitive Skills
C. Problem Solving

1. Analyze a situation to identify a problem to be solved.

a. Represent and/or restate the problem in one or more ways (e.g., graph,table, equation), showing recognition of important details and significant parameter.
b. Break complex problems into component parts that can be analyzed and solved separately.
c. Apply previously learned knowledge to new situations.
d. Analyze a media report, identify any misuse of statistics, and suggest ways to more accurately depict this information.

2. Develop and apply multiple strategies to solve a problem.

a. Use a range of standard methods, devices, techniques, and strategies to gather and analyze information.
b. Use knowledge gained from other subject areas to solve a given problem.

3. Collect evidence and data systematically and directly relate to solving a problem.

a. Use general and specialized reference works and databases to locate sources.
b. Collect evidence and data directly related to solving the problem and eliminate irrelevant information.
c. Produce charts, graphs, and diagrams accurately, including scale, labeling, units, and organization.
d. Present the collected data visually, describe the data collection procedure, and defend choosing that procedure over other possibilities.

(EPIC, 2008, p. 59)

Cross-Disciplinary Standards

Return

II. Foundational Skills

C. Research Across the Curriculum

1. Understand which topics or questions are to be investigated.
- a. Formulate research questions.
- b. Use strategies like those in the writing process to generate questions and areas to pursue.
- c. Consult previous studies or conduct interviews with experts to identify questions central to a research topic.
- d. Propose explicit, testable hypotheses, using the "if ..., then ..." format.

2. Explore a research topic.
- a. Produce an annotated list of sources consulted, differentiating among primary, secondary, and other sources and explain their relevance to the research topic.
- b. Outline the most significant controversies or questions on a research topic.
- c. Plan an investigative study.
- d. Explain reasons for valid competing points of view on a given topic.

3. Refine research topic based on preliminary research.
- a. Gather information from a variety of relevant sources.
- b. Use general and specialized reference works and databases to locate sources.
- c. Locate electronic sources, when appropriate, using advanced search strategies.
- d. Select an appropriate range of source materials.
- e. Analyze a wide range of sources, including technical texts, primary and secondary sources, conflicting points of view, and interdisciplinary research when appropriate.
- f. Design and carry out hands-on experimental investigations, choosing appropriate apparatuses, identifying controls and variables, tentatively predicting the outcome of the procedures, and evaluating whether actual results agree with predicted results.
- g. Use numerical and mathematical tools such as software, including databases, spreadsheets, and other tools, in investigations and explanations.

4. Evaluate the validity and reliability of sources.
- a. State explicitly characteristics or identifying features that indicate accuracy or reliability of sources, to determine whether sources are biased, incomplete, or otherwise unreliable.
- b. Follow a set of criteria to determine the validity and reliability of sources.
- c. Identify claims found in one or more of the sources that require support or verification, and evaluate the information's validity.
- d. Evaluate the data presented in graphics, tables, charts, and maps when appropriate to the topic.

5. Synthesize and organize the information.
- a. Select quotations and evidence that support the thesis.
- b. Determine what evidence best supports conclusions.
- c. Use well-organized strategies to collect and organize information gathered.
- d. Determine the best order for presenting evidence that supports conclusions.

6. Design and present an effective product.
- a. Determine the best order for presenting major and minor points.
- b. Design a report using features such as headings and graphics appropriate to the writing task.
- c. Use a citation system specified by or appropriate to the assignment.

(EPIC, 2008, p. a63)

Cross-Disciplinary Standards

Return

II. Foundational Skills

A. Reading Across the Curriculum

1. Use effective pre-reading strategies.
- a. Use the title, knowledge of the author, and place of publication to make predictions about a text.
- b. Use a table of contents to preview a text and understand its design.
- c. Scan headline sections or other division markers, graphics, or sidebars to form an overview of a text.

2. Use a variety of strategies to understand the meanings of new words.
- a. Use context clues, including definitions, examples, comparison, contrast, cause, and effect, and details provided in surrounding text.
- b. Consult references (e.g., dictionary, thesaurus) effectively.
- c. Understand notation specific to discipline (e.g., mathematical notation, scientific symbols).

3. Identify the intended purpose and audience of the text.
- a. Predict purpose and audience of a text based on the title, preface, and other features of a text.
- b. Explain how the language of an effective text targets an intended audience.
- c. Explain the importance of a technical and/or scientific article.

4. Identify the key information and supporting details.
- a. Outline a chapter of an informational text.
- b. Summarize the major points in a text, and use graphic organizers (e.g., concept maps, diagrams) to organize ideas and concepts in a visual manner.
- c. Analyze connections between major and minor ideas.
- d. Identify and define key terminology from technical and/or scientific documents.

5. Analyze textual information critically.
- a. Identify faulty premises in an argument.
- b. Identify stated and implied assumptions.
- c. Identify conclusions unsupported by sufficient evidence in informational texts.
- d. Use inductive and deductive reasoning.
- e. Draw conclusions based on evidence, support, or data through logical reasoning.
- f. Compare a primary source and an interpretation in a textbook.

6. Annotate, summarize, paraphrase, and outline texts when appropriate.
- a. Outline an informational or literary text.
- b. Annotate text for comprehension and analysis.
- c. Summarize an article to demonstrate comprehension.
- d. Paraphrase a writer's ideas or findings.

7. Adapt reading strategies according to structure of texts.
- a. Identify a variety of textual forms and genres (e.g., long and short texts) and adapt reading strategies accordingly.
- b. List strategies to use during reading, including:
  - Anticipate and predict what information the text is likely to contain.
  - Monitor understanding by self-questioning.
  - Use strategies (e.g., mental imagery, paraphrasing, information in glossaries) to re-examine the text if comprehension fails.
  - Reread difficult passages.
  - Read ahead for additional clarification.
  - Self-monitor and summarize the information gained.
- c. Explain how form or genre communicates meaning.

(EPIC, 2008, p. a63)

Cross-Disciplinary Standards

Return

I. Key Cognitive Skills	
D. Academic Behaviors	E. Work Habits
1. Self monitor learning needs. a. Ask questions to check for understanding or to clarify information. b. Use a systematic method for recording, storing, and organizing materials and resources; avoid haphazard or messy accumulation of information. **2. Use study habits necessary to manage academic pursuits and requirements.** a. Manage time effectively to complete tasks on time. b. Demonstrate accurate note-taking. c. Use the appropriate level of detail necessary to complete an assigned task. d. Balance academic and non-academic activities to successfully participate in both. **3. Strive for accuracy and precision.** a. Collect and report experimental data carefully and correctly. b. Produce charts, graphs, and diagrams accurately, including scale, labeling, units, and organization. c. Eliminate irrelevant information from an assignment. **4. Persevere to complete and master tasks.** a. Persevere until a task is completed by working even when faced with uncertainty or open-ended assignments. b. Seek assistance when needed to complete the assignment. c. Recognize when a task is completed. *(EPIC, 2008, p. a60)*	**1. Work independently.** a. Plan a project, establish its parameters, and complete it with minimal supervision, seeking assistance accordingly. b. Follow directions or procedures independently. c. Complete assignments outside the classroom setting in a timely manner. **2. Work collaboratively.** a. Work collaboratively with students from various cultural and ethnic backgrounds. b. Distinguish between situations where collaborative work is appropriate and where it is not. c. Work in small groups to investigate a problem or conduct an experiment. *(EPIC, 2008, p. a60)*

Cross-Disciplinary Standards

Return

I. Key Cognitive Skills
E. Work Habits
2. Work collaboratively. a. Work collaboratively with students from various cultural and ethnic backgrounds. b. Distinguish between situations where collaborative work is appropriate and where it is not. c. Work in small groups to investigate a problem or conduct an experiment. *(EPIC, 2008, p. a60)*

English Language Arts Standards

Return

III. Speaking	
A. Understand the elements of communication both in informal group discussions and formal presentations.	B. Develop effective speaking styles for both group and one-on-one situations.
1. Understand how style and content of spoken language varies in different contexts and influences the listener's understanding. a. Understand influences on language use (e.g., political beliefs, positions of social power, culture). b. When speaking, observe audience reaction and adjust presentation (e.g., pace, tone, vocabulary, body language) to suit the audience. **2. Adjust presentation (delivery, vocabulary, length) to particular audiences and purposes.** a. Use effective verbal and non-verbal response strategies to adjust the message in response to audience's facial expressions and body language. *(EPIC, 2008, p. a9)*	**1. Participate actively and effectively in one-on-one oral communication situations.** a. Communicate, in an appropriate format, information that was gathered by inquiry (e.g., research, interviews). b. Communicate understanding of materials, concepts, and ideas (e.g., conference with instructor on a complex assignment). **2. Participate actively and effectively in group discussions.** a. Cooperate with peers to organize a group discussion: establish roles, responsibilities, ground rules; complete assignments; evaluate the work of the group based on agreed-upon criteria. b. Use discussion techniques to arrive at a consensus or complete a task. **3. Plan and deliver focused and coherent presentations that convey clear and distinct perspectives and demonstrate solid reasoning.** a. Present research findings as appropriate in a variety of settings. b. Use clear and concise language to explain complex concepts. c. Practice speaking from notes as well as from a prepared speech. d. Use appropriate media for public presentations. *(EPIC, 2008, p. a9)*

Cross-Disciplinary Standards

Return

II. Foundational Skills

B. Writing Across the Curriculum

1. Write clearly and coherently using standard writing conventions.

a. Prepare a topic proposal that specifies a purpose and justifies the choice of audience to achieve that purpose.
b. Craft a thesis statement that articulates a position and list relevant evidence and examples in logical groupings.
c. Use symbols, diagrams, graphs, and words to communicate ideas.
d. Use appropriate terminology and data expression to communicate information in a concise manner.
e. Use a variety of reference guides for citation conventions, grammar, mechanics, and punctuation.

2. Write in a variety of forms for various audiences and purposes.

a. Present an argument supported by relevant evidence, examples, and counterarguments.
b. Prepare a summary article or report, extracting in brief form the pertinent information.
c. Evaluate articles by analyzing the study design, data source, graphical representation of data, and analyzed data results reported (or not reported).
d. Write a reflection about the process selected to conduct research or solve a problem.
e. Write accurate and understandable lab reports and technical documents.

3. Compose and revise drafts.

a. Submit a writing assignment to be proofread by a teacher, parent, or other student. Revise the paper, incorporating constructive criticism when appropriate.
b. Edit text for correct spelling, capitalization, and punctuation.
c. Edit for appropriate tense and voice.
d. Edit for correct word use.
e. Use a variety of reference guides for citation conventions, grammar, mechanics, and punctuation.
f. Submit a final draft that is easily read and has few or no grammatical or spelling errors.

(EPIC, 2008, p. a60)

Cross-Disciplinary Standards

Return

II. Foundational Skills
E. Technology

1. Use technology to gather information.
- a. Use the Internet or other appropriate technologies to post survey questions on an assigned topic.
- b. Use devices to measure physical properties.
- c. Use online databases to access scholarly work on an assigned research topic.

2. Use technology to organize, manage, and analyze information.
- a. Use data analysis software to analyze survey results.
- b. Use spreadsheets to manage and organize statistical data.

3. Use technology to communicate and display findings in a clear and coherent manner.
- a. Create spreadsheets and graphs to communicate findings in a presentation that includes graphics, visuals, or other supporting images.
- b. Utilize technology to present information and/or data in a variety of ways.

4. Use technology appropriately.
- a. Explain how technology is a useful and effective tool to communicate findings.
- b. Identify when technology may not be necessary or appropriate to communicate findings.
- c. Formulate strategies to communicate findings with and without technology.

(EPIC, 2008, p. a65)

Mathematical Standards

IV. Communication and Representation	
A. Language, terms, and symbols of Mathematics.	B. Interpretation of mathematical work.
1. Use mathematical symbols, terminology, and notation to represent given and unknown information in a problem. a. Use variables to represent quantities in contextual situations. b. Analyze problem situations and represent them using algebraic expressions and equations. c. Use and understand the many ways an "=" sign is used (e.g., to state a definition or formula; to represent an identity; to express a conditional equation; to identify constant and variable terms in expressions, equations, and inequalities). d. Understand and use interval, set, and function notation. e. Understand that certain symbols and words can have multiple meanings [e.g., (1, 2) can represent a point or an interval]. **2. Use mathematical language to represent and communicate the mathematical concepts in a problem.** a. Represent information in a problem using algebraic expressions, equations, and inequalities. b. Recognize contextual problems represented by linear and non-linear models. **3. Use mathematics as a language for reasoning, problem solving, making connections, and generalizing.** a. Use inductive and deductive reasoning to reach valid conclusions. b. Write the converse, inverse, and contrapositive of any given conditional statement.	**1. Model and interpret mathematical ideas and concepts using multiple representations.** a. Make tables of inputs and outputs for mathematical relations functions. b. Write symbolic representations for a verbal description of a relationship. c. Construct visual representations (e.g., a graph) of relationships. d. Describe orally or in written format the behavior of a mathematical idea using graphs, diagrams, tables, and algebraic representations. e. Represent inequalities using graphs, interval notation, and set notation. f. Use multiple representations of rate of change. **2. Summarize and interpret mathematical information provided orally, visually, or in written form within the given context.** a. Interpret mathematical information in an article from a media source. b. Summarize mathematical information given orally and visually in a media report. *(EPIC, 2008, p. a19)*

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Mathematical Standards

Return

IV. Communication and Representation

C. Presentation and representation of mathematical work.

1. Communicate mathematical ideas, reasoning, and their implications using symbols, diagrams, graphs, and words.

a. Communicate ideas mathematically using symbols (e.g., equal signs, parentheses, subscripts, superscripts, order relations, set notation).
b. Develop geometric models to represent concepts and relationships (e.g., scatter plots).
c. Recognize and explain the meaning of information presented using mathematical notation.

2. Create and use representations to organize, record, and communicate mathematical ideas.

a. Use Venn diagrams to represent sets of real numbers, surveys, and other set relationships.
b. Show solutions of equations and inequalities, and solutions of systems of and inequalities, using the real number line and rectangular coordinate system.
c. Construct and use graphic organizers (e.g., tables, bubble maps, Venn diagrams, tree diagrams).

3. Explain, display, or justify mathematical ideas and arguments using precise mathematical language in written or oral communications.

a. Explain reasoning in both oral and written forms using notation, terminology, and logic.
b. Communicate reasons associated with performing steps in algebraic methods (e.g., explaining why a quadratic equation must be written in standard form first when solving by factoring).
c. Identify units associated with any variables and constants used in a problem solution.

(EPIC, 2008, p. a19)

Social Studies Standards

Return

V. Effective Communication	
A. Clear and coherent oral and written communication	B. Academic integrity
1. Use appropriate oral communication techniques depending on the context or nature of the interaction. a. Debate the pros and cons of a research question. b. Prepare for and actively participate in a class discussion on a historical conflict. **2. Use conventions of standard written English.** a. Utilize standard written English in formal writing assignments and proofread to correct grammar, spelling, and punctuation errors. b. Share drafts of writing assignments with teachers, parents, or other students and then revise as appropriate.	**1. Attribute ideas and information to source materials and authors.** a. Identify ethical issues and consequences surrounding plagiarism. b. Demonstrate knowledge of copyright and fair use laws by adherence to these laws in all assignments. c. Reference research material using appropriate citation/referencing styles (e.g., The Modern Language Handbook for Writers of Research Papers, The University of Chicago Manual of Style). d. Write an essay that includes citations of both paraphrased material and directly quoted material. e. Identify the code of conduct involving academic honesty at your school, a local college, or university, and list several examples of what constitutes a violation of this code and the punishment for violating it. f. Explain why an academic integrity standard is necessary and the consequences of violating it. *(EPIC, 2008, p. a57)*

Science Standards

III. Foundation Skills: Applications of Communication
A. Scientific Writing
1. Use correct applications of writing practices in scientific communication. a. Construct word (narrative) descriptions of apparatuses, equipment, techniques and procedures, data, and other features of scientific investigations with sufficient clarity that a layman reader can comprehend and replicate the items or arrangements being described. b. Write accurate and understandable lab reports and technical documents. c. Prepare a summary or abstract of a technical article or report, extracting in brief form the pertinent information. d. Use appropriate terminology and data expression to communicate information in a concise manner. e. Give credit to original authors including online or electronic sources and never take credit for words that are not one's own. f. Write a technical report including a bibliography and proper documentation of sources using a standard style. *(EPIC, 2008, p. a28)*

Continued on next page...

Science Standards

Return

III. Foundational Skills

B. Scientific Reading

1. Read technical and scientific articles to gain understanding of interpretations, apparatuses, techniques or procedures, and data.

a. Describe the contents of a technical or scientific article.
b. Explain the importance of a technical or scientific article.
c. Make reasonable conclusions or predictions from given scientific article data.

2. Use a variety of strategies to understand the meanings of new words.

a. Follow a written procedure to set up and perform a lab activity.

3. Recognize scientific and technical vocabulary in the field of study and use this vocabulary to enhance clarity of communication.

Predict purpose and audience of a text based on the title, preface, and other features of a text.

a. Identify and define key scientific terminology from technical and scientific documents.

4. List, use and give examples of specific strategies before, during, and after reading to improve comprehension.

a. List strategies to use before reading, including: activate prior knowledge of the topic, gain a clear understanding of the goal or purpose of the reading, and analyze the way in which the material is structured.
b. List strategies to use during reading, including: focus attention on the text; anticipate and predict what information the text is likely to contain; monitor understanding by self-questioning and the use of strategies (e.g., mental imagery, paraphrasing, information in glossaries) to re-examine the text if comprehension fails; reread difficult passages or read ahead for additional clarification; seek outside help for clarification; frequently self-monitor and summarize the information that has been gained.
c. List strategies to use after reading, including: summarize the major points in the text and use graphic organizers (e.g., concept maps, problem-solution diagrams, cycle diagrams) to organize terms and concepts from the text in a visual manner.

(EPIC, 2008, p. a29)