


# The Importance of Using the Cross-Disciplinary Standards in Math and Science

**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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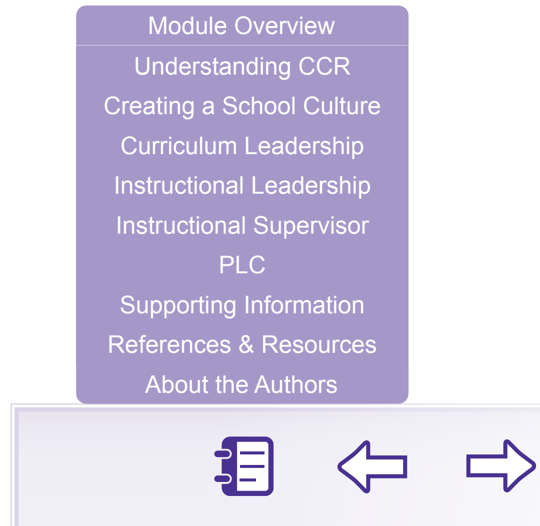


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# Module Overview

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Watch the The Importance of Using the Cross-Disciplinary Standards in Math and Science.

# 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. 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.

# Module Overview

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:

- how to integrate 21st century skills into teacher repertoires,
- how to embed the cross-disciplinary skills in demonstration lessons,
- how to teach reading comprehension skills in mathematics and science, and
- 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 one 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 expectations of the College and Career Readiness Standards into your daily practice; our students are worth it."*

# Components of the Module

While the College and Career Readiness Standards (CCRS) are organized into four distinct disciplinary areas, English/language arts, mathematics, science, and social studies, there are elements that cut across the disciplines, the Cross-Disciplinary Standards.

This module will introduce the Cross-Disciplinary Standards and provide examples for high school mathematics and science. These examples will assist the in-service and pre-service teachers embed the Cross-Disciplinary Standards into their own lessons.

For students to be college and career ready, they must have command of these standards; therefore, it is imperative that in-service and pre-service teachers understand and expect their students to practice and incorporate the strategies and skills inherent in these standards.

Figure 1 notes the areas that will be addressed of the Cross-Disciplinary Standards.

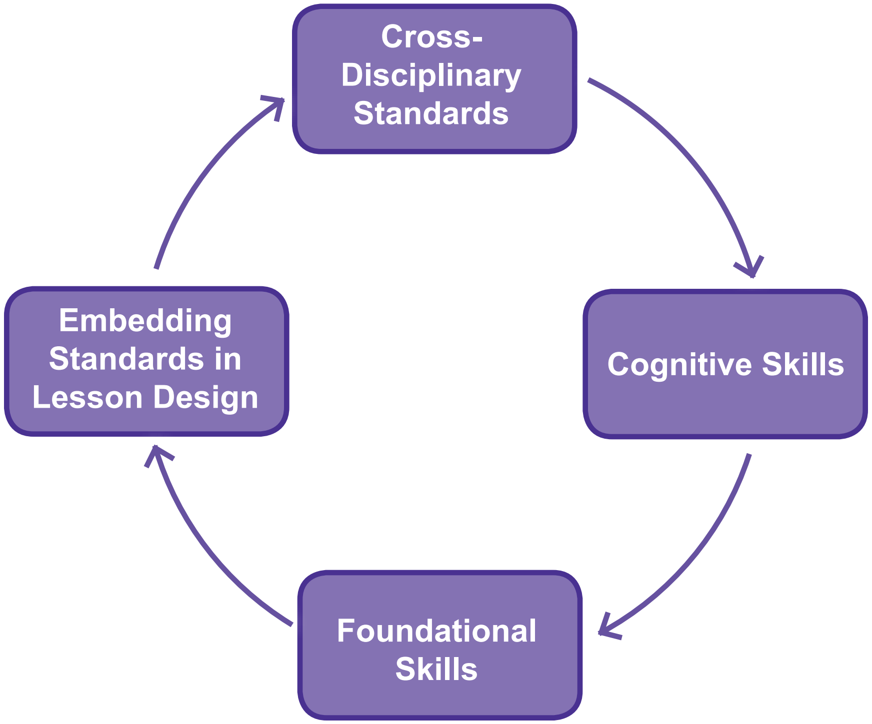



Figure 1


# Introduction to Cross-Disciplinary Standards

# 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 also have been noted as critical to the workplace.

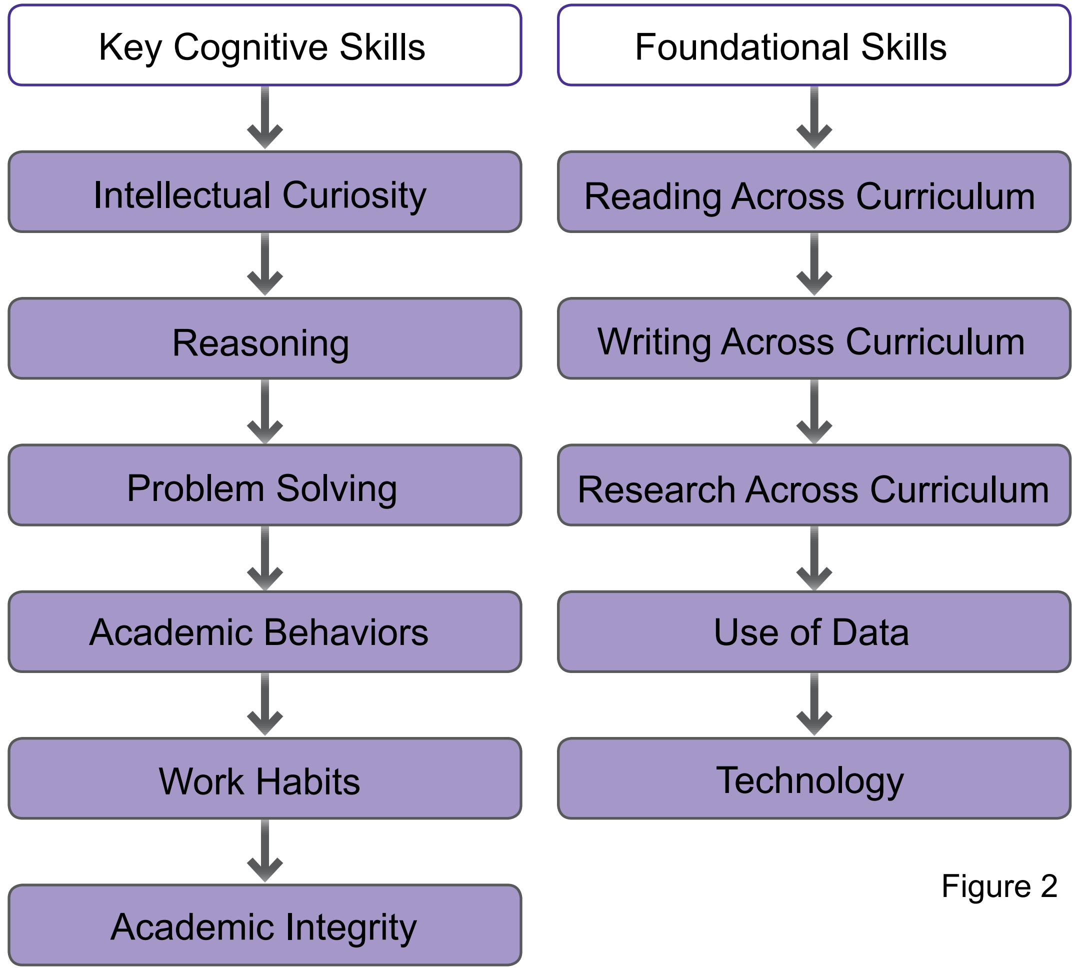


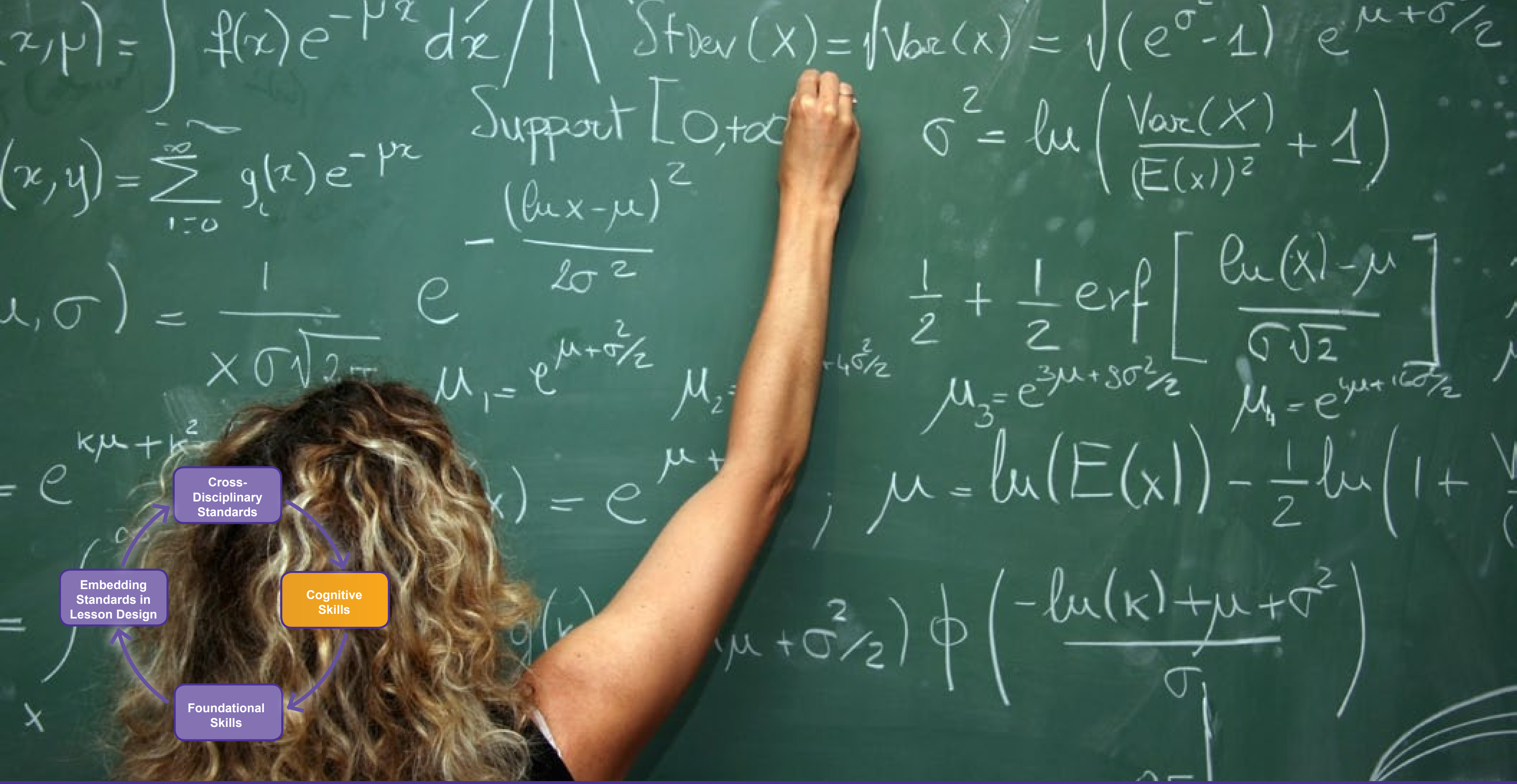

Figure 2

# Exploring the Cross-Disciplinary Standards

**Importance of Cross-Disciplinary Standards**

The College and Career Readiness Standards Booklet defines their importance, "These Cross-Disciplinary Standards 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.




# Key Cognitive Skills

# Exploring Cognitive Skills

Conley defines cognitive skills as “strategies that enable students to use content from a range of disciplines. They describe intentional practiced behaviors that students consistently apply in a variety of learning situations” *(Conley, 2010, p. 32-33)*. For the purpose of this section, the three cognitive skills as shown in Figure 3 will be introduced. The CCRS also includes three other standards in the Key Cognitive Section: Academic Behaviors, Work Habits, and Academic Integrity which will also be discussed.

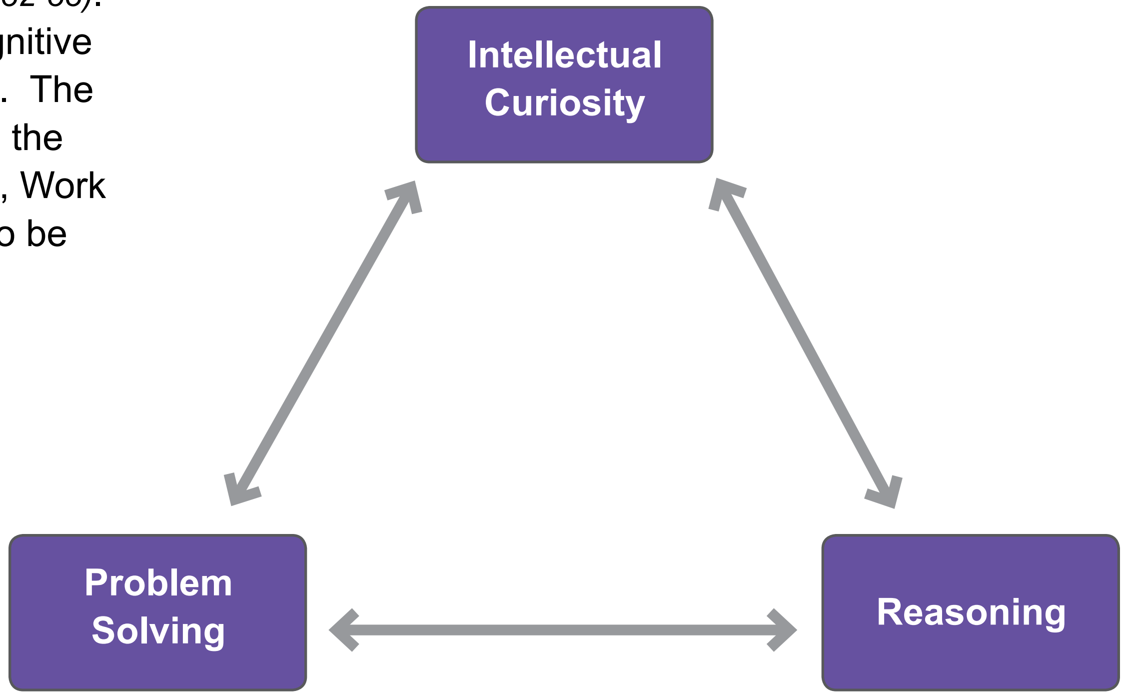



Figure 3

# Intellectual Curiosity

For mathematics and science, intellectual curiosity regarding inquiry involves conducting investigations, identifying what is known, unknown, and possibly what one wants to know. Intellectual curiosity involves the "what if" logic. For science, it is the prediction or hypothesis that carries you to defending if something is right or wrong.

Part of being intellectually curious is giving illustrations or opinions when no clear answer is apparent. For mathematics and science it may include stating your point with valid evidence while being willing to change your point of view when data warrants such.

For mathematics and science, intellectual curiosity plays a critical role in understanding how concepts are connected in addition to new discoveries. Without intellectual curiosity, the student can only repeat what others have said or done, or only replicate what he/she has practiced.

**Connecting Intellectual Curiosity to the College and Career Readiness Standards**

The CCRS directly addresses intellectual curiosity as students are expected to engage in dialogue, conduct investigations, and articulate findings as well as defend their point of view.

Learn more about the state's alignment team's listing of performance examples for this standard.

# Strategy: Cognitive Skills

## Intellectual Curiosity

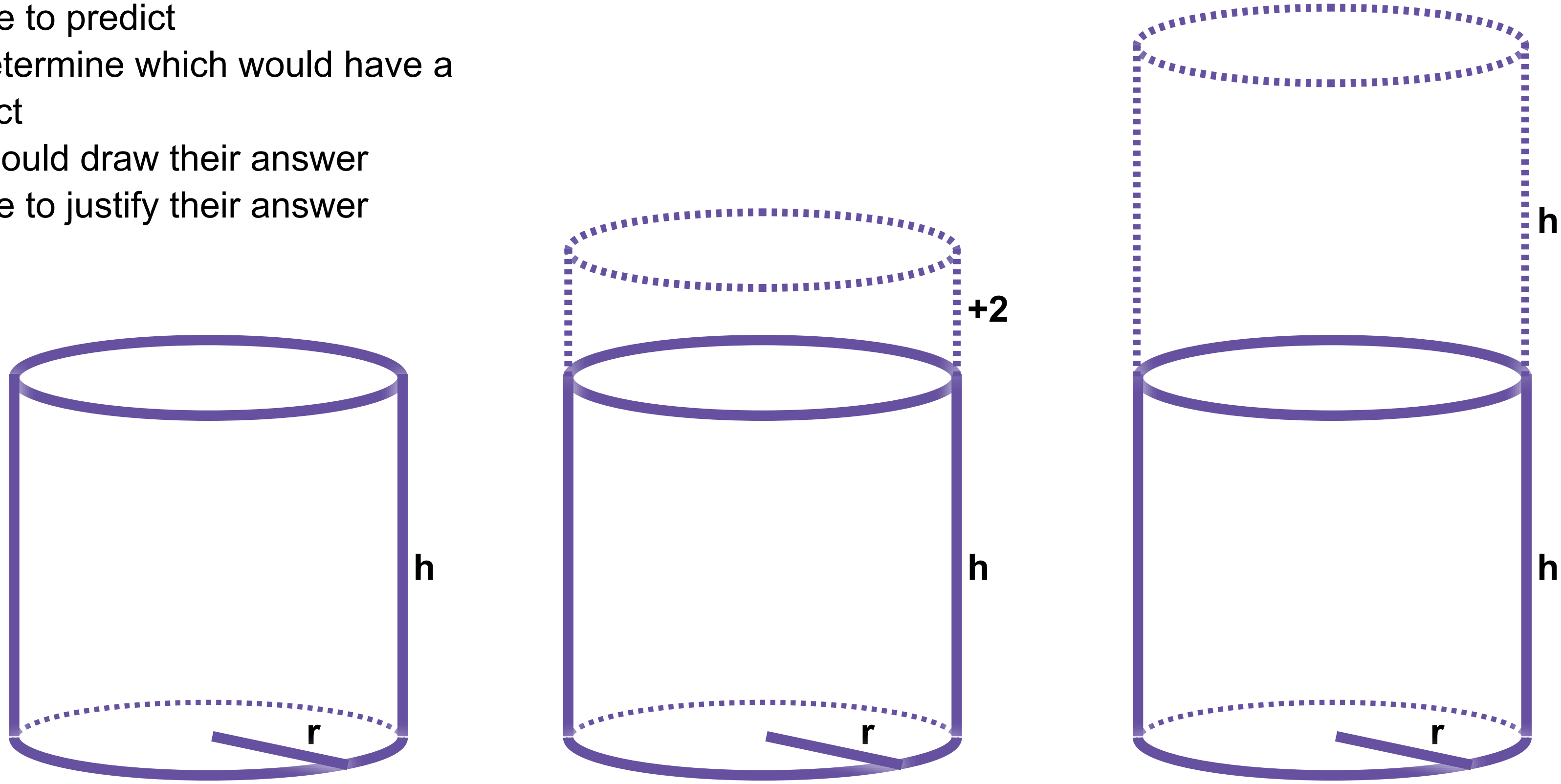
- Provide engaging yet challenging problems, those that require more than a rote procedure.
- Present problems that require clear-cut applications of learned materials in addition to more complex critical thinking.
- Require students to think about their answers in the context of the problem.


## Content Objective: Dimensional Change

### Exploring Dimensional Relationships

Given a cylinder, if you change the dimension by adding 2 (h+2) or multiplying (2h) , which would have the greater effect on volume and surface area?

- Students are to predict
- Students determine which would have a greater affect
- Students should draw their answer
- Students are to justify their answer




Learn more about the Cross-Disciplinary Standards' connection to this example.

# Science Example: Intellectual Curiosity

## Content Objective: Chemical Change

### Chemical Change

- Do not give students products of process

  $NaCl + H_20$ ____________

  $AgNO_3 + NaCl$ ____________

- Have students predict possible outcomes of changes (products)
- Combine reactants ($NaCl + H_20$) and ($AgNO_3 + NaCl$)
- Record any observations (evidence of change)
- What should students be looking for (visible change, odor change, temperature change, precipitate formed, evolution of gas)
- Students make a claim based on their observation (evidence)

- Have students answer:
  - How certain are you of your claim?
  - What other tests could you perform?
  - What are the problems when trying to determine whether a process is chemical or physical?

Learn more about the Cross-Disciplinary Standards' connection to this example.

# Reasoning

In the Cross-Disciplinary Standards, reasoning involves gathering and interpreting data/evidence and to construct and support well-reasoned arguments as well as evaluating data/evidence/arguments of self and others.

For mathematics, this may mean forming conjectures and justifying statements. For science, this may mean justifying your arguments.

**Importance of Reasoning**
Mathematics and science reasoning is more about the process rather than the correct answer. Understanding the logical order plays a critical role; the process requires the student's ability to reason.

In science, the student must be able to think critically through a problem, with numbers visually representing results, and to understand the changes that those numbers represent. All of this requires the ability to reason.

**Connecting Reasoning to the College and Career Readiness Standards**
The CCRS directly address reasoning as students are expected to apply logic to analyze patterns, establish a hypothesis, analyze data, and then draw conclusions. Learn more about the state's alignment team's listing of performance examples for this standard.

## Reasoning

Provide an environment where students are engaged:

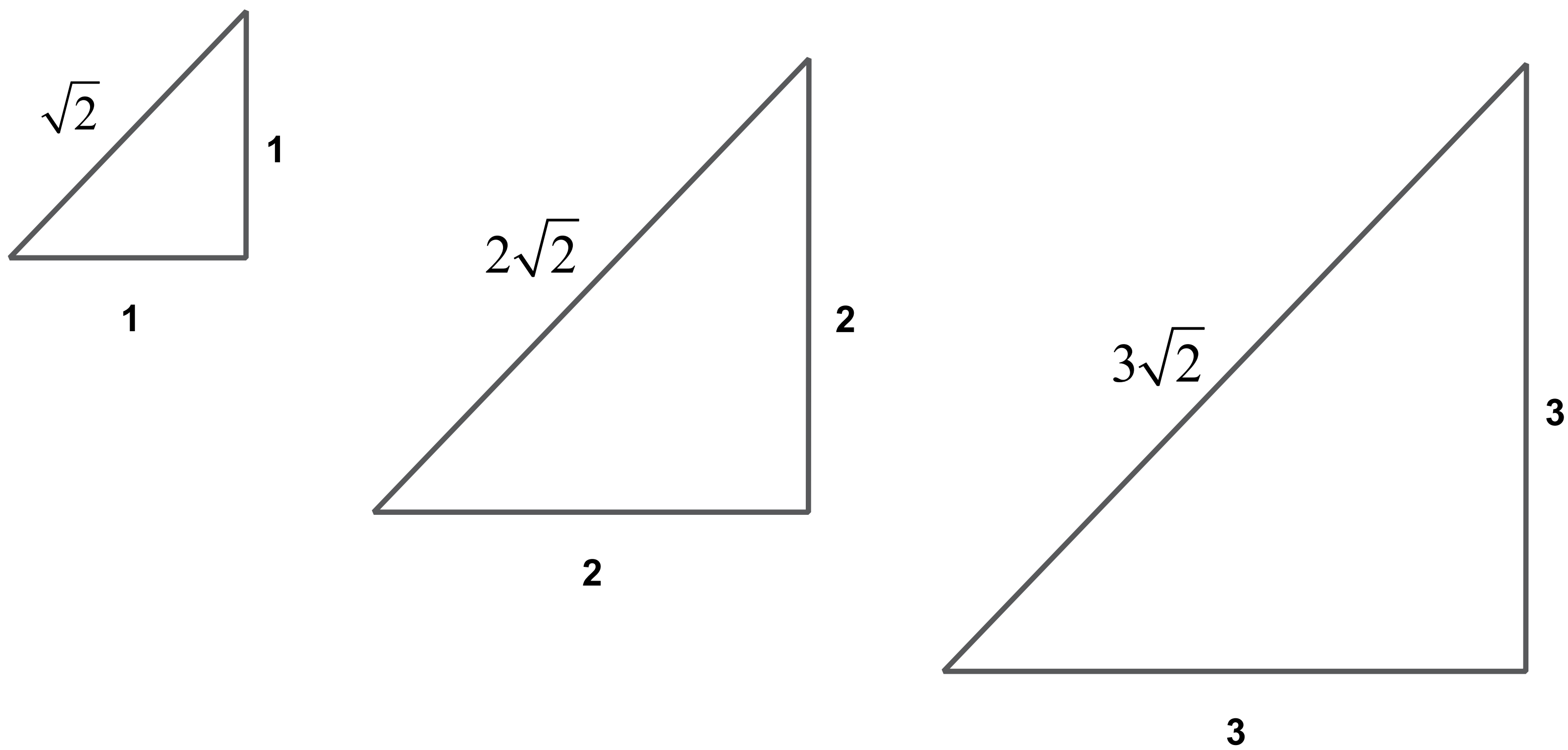
- First, successful learners are mathematically active *(Anderson, Reder, & Simon, 1996)*. Passive strategies (memorization, drill, templates) are much less likely than active tasks (discussion, projects, teamwork) to produce either lasting skills or deep understanding.

- Second, successful mathematic learners are more likely to engage in reflective (or "metacognitive") activity *(Resnick, 1987)*. Students who think about what they are doing and why they are doing it are more successful than those who just follow rules they have been taught *(Steen, 1999)*.

# Mathematics Example: Reasoning

## Content Objective: Pythagorean Theorem

**Using Patterns to Develop Special Relationships of Right Triangles**
Students are to determine patterns to develop conceptual understanding of relationships in special right triangles rather than being given a formula.




Learn more about the Cross-Disciplinary Standards' connection to this example.

# Science Example: Reasoning

## Content Objective: Grouping of Elements

Mendeleev was the first scientist to make a periodic table similar to the one we use today. While arranging cards of elements including properties, Mendeleev began to observe patterns when elements were arranged according to atomic weight. Mendeleev was able to reason from arrangement of elements that some elements were yet to be discovered and was also able to predict the properties of elements.

Describe the grouping of elements that you observe using the Periodic table.


Some reasoning questions from STEPS teachers:

- We all begin as one cell. Are you still one cell? Why or Why not?
- Why do you look like your mother and your siblings look more like your father?
- When you sprinkle sugar on a strawberry, why does juice come out?

Learn more about the Cross-Disciplinary Standards' connection to this example.

# Problem Solving

For mathematics and science, problem solving involves breaking a problem into parts, determining from multiple strategies the best methods to gather and analyze information, collecting data while eliminating anything irrelevant, describing the data, and being able to defend the choice of procedures.

**Importance of Problem Solving**
Problem solving includes skills and functions which are an important part of everyday life, the real world. It is the means in which students take the known and apply the strategy to unknown situations. Without problem-solving skills, students cannot make connections that enable them to solve problems at the next level.

"Not all problems are posed as 'apply specific skill' as in 'Find the vertex of a parabola using the formula.' Most often we have to figure out what skills we have to use to solve the problem."

*(STEPS faculty)*

**Connecting Problem Solving to the College and Career Readiness Standards**
The CCRS directly address problem solving as students are expected to develop and apply multiple strategies to solve problems. Learn more about the state's alignment team's listing of performance examples for this standard.

## Problem Solving: Intro

The challenge as noted by our STEPS teachers is to develop the process of mathematical and /or scientific thinking so that even routine mathematic tasks are approached through a problem-solving contexts. The goal is to develop deep understanding of mathematics and science.

A routine process in which the STEPS faculty engages their students is an adaptation of Polya's Four Step Model. Known as Polya's Problem Solving Process (PPSP).

STEPS mathematics and science teachers suggest that reasoning is required during the problem-solving process. To them, problem solving is the approach used to derive a solution. Reasoning is the more formal analysis that transpires as a problem is solved.

*George Polya*
*(http://wik.ed.uiuc.edu)*

## Problem Solving: Step 1


### 1 Understand the Problem

What do you have to show? One of the most important parts of understanding the problem is making sure that we know the definition of each word in the problem. If a student has to find the vertex of a parabola and he doesn't know what a parabola or a vertex is, it is quite natural to claim "I don't know how to start!" There are many avenues to reinforce (internet, games, social media, consulting a text) vocabulary, but first students need to recognize that their vocabulary knowledge is deficient.

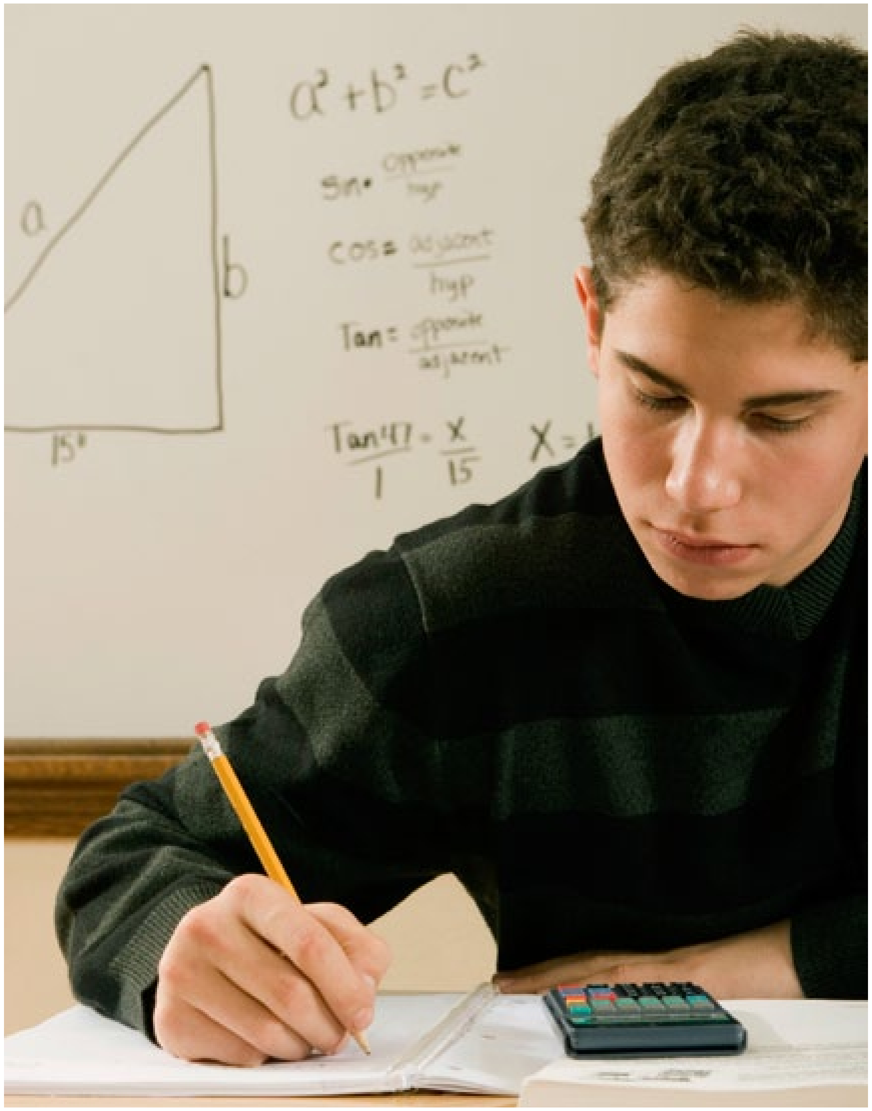
Before pointing to notes, internet or text, we should ask students to restate what they are being asked to do or show to be sure they understand. They can use graphic organizers like Venn diagrams, KWL charts and others to draw a picture of what they have to show.

## Problem Solving: Step 2

### 2 Devise a Plan

What do you know? In devising a plan to solve the problem, students can again use graphic organizers to summarize what they know about a problem. This includes not only definitions, but also previously solved problems, partial solutions, or related concepts not directly referred to but perhaps useful for solving a piece of the problem.

Often I'll ask students if there is a similar, but easier problem that we can try before tackling a more complicated problem. Having to recognize "similar but easier" is a bit less difficult than having to restate a problem oneself, but still is effective in practicing reading comprehension.



## Problem Solving: Step 3

### 3 Carrying Out the Plan

Carrying out the plan formed in the first two steps of PPSP is often the easiest part of making a solution because the task of making sense of what we have to show and what we know is done. During the “carry out the plan” phase, we can emphasize understanding and checking each step (as opposed to applying steps on the board or in a text example) and careful communication of the solution! Having to verbally communicate steps of a solution reinforces reading comprehension. If putting a solution into words is a routine part of the problem-solving task, decoding others’ words becomes routine also.

## Problem Solving: Step 4

### 4 Looking Back

The last step in PPSP is looking back. When we have solved a problem, we don't just wipe our brow and say, "phew, I'm glad that's over!" We need to reflect on what we've learned. We can verify the accuracy of our solution by seeing if it makes sense intuitively. Could the techniques we just used help us solve other problems? Could we have solved our problem differently? If different solutions are presented, are they both valid? Are they equivalent? Take a moment to store our steps because they will be useful for other problems as well.

Our STEPS teachers add one more question, "Is it reasonable and is it practical?"

## Content Objective: Quadratics

**Revenue Function**

Revenue function for a television manufacturer is given by: $R(x)=-x^2 + 500x$

Here, x is the number of televisions produced. Find the number of televisions that should be produced to maximize revenue.

**1**

**Understand the Problem (what do you have to show?):** Students need to read the problem several times until they understand that R(x) is a rule that allows us to input the number of televisions x to get the revenue associated with making that many televisions. They may need to review words like “function” and look up words like “revenue.” Teachers can model that a knowledge of what to do is not immediate.

**2**

**Devise a Plan (what do you know?):** Students need to bring together previously learned skills to solve this problem. Notice that revenue is determined by a quadratic function for which the graph is parabolic. Maximum revenue corresponds to the y coordinate of the “highest” point. We can find that highest point because it is the vertex. There are various avenues we can utilize to find the vertex. We can find the vertex of a parabola by completing the square, using the vertex formula, graphing the equation, or using a table of values.

Continued on next page...

# Mathematics Example: Problem Solving

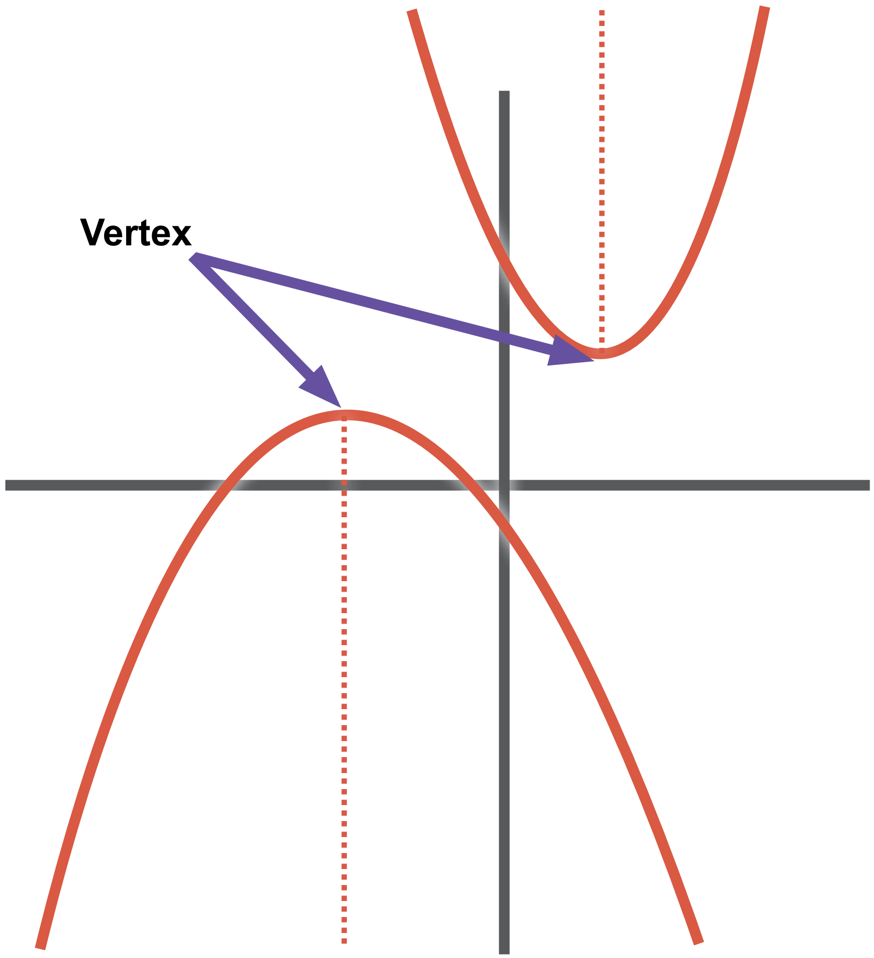
## Content Objective: Quadratics

3

**Carry Out the Plan:** If you utilize the algebraic method to carry out the plan, we compute the x-coordinate of the vertex given by x= -b/(2a) where b is the leading coefficient of the linear term and a is the coefficient of the squared term. So x=-500/(2(-1))=250. So 250 is the number of televisions which will produce maximum revenue.

4

**Looking Back:** To look back, we reflect on what we have applied. For example, we can notice that by using the same tools, we could find the minimum for a function described by a parabola opening up.




*(SFA mathematics faculty)*

Learn more about the Cross-Disciplinary Standards' connection to this example.

# Science Example: Problem Solving

## Content Objective: Genetics

**Klinefelter's Syndrome**

In humans, each cell normally contains 23 pairs of chromosomes, for a total of 46. In our situation however, you have a person with 47 chromosomes. Instead of XX you have XXY.

- How could XXY happen?
- What went wrong?
- Are there any more than our possible scenario?

**1** **Understand the Problem (what do you have to show?):** The student needs to know that the problem wants to determine what went wrong.

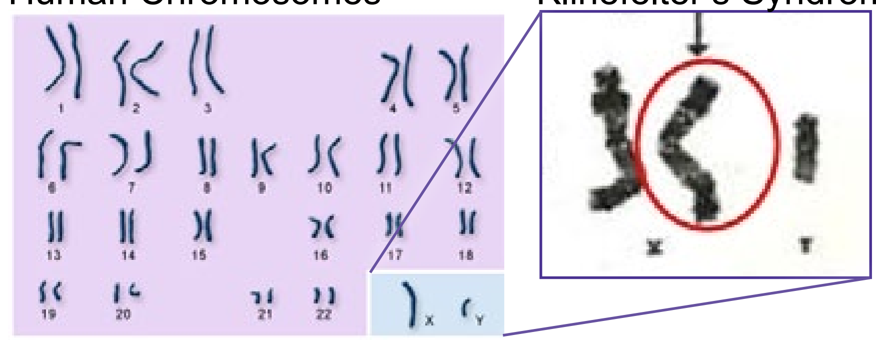
**2** **Devise a Plan (what do you know?):** The student would need to connect prior knowledge of how cells divide and how the sex of an offspring is determined.

**3** **Carry Out the Plan:** The student would review meiosis. They could possibly use the Punett square to visualize possible X and Y chromosome combinations and the corresponding steps to find out what happened.

**4** **Looking Back:** The student should ask themselves "do I have the correct number of chromosomes?"

Human Chromosomes

Klinefelter's Syndrome



*(AC Biology faculty)*

Learn more about the Cross-Disciplinary Standards' connection to this example.

# Academic Behaviors

**Academic Behaviors**
Behaviors where students demonstrate an understanding of themselves and their abilities, and are then able to employ certain skills for self management, such as student self-awareness, self-monitoring, and self-control.

Academic behaviors also include student work habits such as working independently and collaboratively, as well as academic integrity which include issues of attribution, source evaluation, multiple perspectives, and copyright laws.

**Importance of Academic Behaviors**
Academic behaviors are life long skills. We all face situations when we must self-monitor our product, review its accuracy, and persevere until it is completed. For mathematics and science, accuracy and precision are fundamental, particularly in a lab setting. The ruler can be precise but not accurate. Students must self-monitor as they reason and problem solve and apply different strategies to check for errors.

**Connection of Academic Behaviors to the College and Career Readiness Standards**
The Cross-Disciplinary Standards directly address academic behaviors as vital skills for postsecondary and career success. Learn more about the state's alignment team's listing of performance examples for this standard.

## Academic Behaviors

- The goal should be for the student to become an independent learner. The teacher needs to provide structure but also provide unstructured situations so students develop strategies and seek help only when necessary.

- The STEPS mathematics and science teachers recommend the Think Aloud strategy. The Think-Aloud strategy asks students to say out loud what they are thinking about when solving mathematics and science problems. Teachers should model "Think-Aloud" on a regular basis; this can show students the sequence of steps needed to solve a problem, the rationale behind each of these steps, and the importance of precision and accuracy. By doing this, they demonstrate practical ways of approaching difficult problems and reveal complex thinking processes.

They typically pursue a process which follows as such:

- Do I understand the vocabulary?
- Do I have the correct skill set?
- Do I have appropriate prior knowledge?
- Did I establish an appropriate plan?
- Did I determine reasonableness?

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# Strategy: Cognitive Skills

## Academic Behaviors

- Model different learning styles, explaining to students that we all learn differently. Encourage students to determine their best learning style and use it.
- For the English language learner, remember the importance of using visual objects, cognates, and synonyms as further ways to clarify the term.

**"If you have no idea where you are going, you are more than likely not going to get there."**

*(STEPS Science Teacher)*

# Work Habits

Work habits are those skills that one develops that enable a person to meet the demands of a project or job in accordance with teacher or employment standards.

**Work Independently**
Postsecondary students must possess sufficient work habits to follow directions and procedures independently. They are required to plan a project and complete that project independently. They must be able to transition from relying upon the high school teacher's managing each step of their projects to self-monitoring those steps independently.

**Collaborative Skills**
Collaboration is the key to working successfully with others in the workplace or in life. Collaborative skills enable students to interact successfully with a wide range of faculty, students, or workplace colleagues who may come from different backgrounds, have different academic abilities, and hold different points of view. Collaborative skills also enable students to complete an assignment or a project by incorporating the strengths of group members.

# Work Habits

**Importance of Work Habits**

In the secondary and postsecondary classroom, the student cannot possibly learn to a level of deep understanding solely in class time alone. Students must possess work habits skills that enable them to work with others and to independently ascertain what they understand and where they need to spend their time. Much of mathematics and science takes time and must be practiced to learn, with learning building on itself. Students must learn work habits under supervision so when they move to the postsecondary setting, they are able to apply them independently.

**Connection of Work Habits to the College and Career Readiness Standards**

The CCRS address work habits as the ability to work independently and collaboratively. Learn more about the state's alignment team's listing of performance examples for this standard.

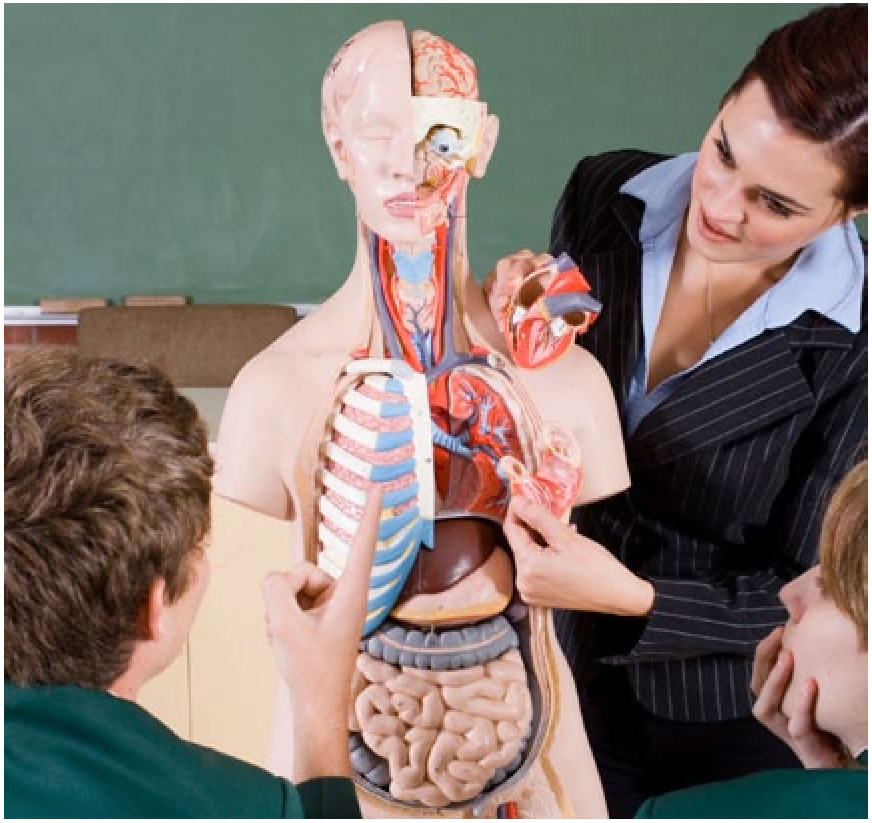
## Work Habits

Our STEPS high school teachers have distinguished the difference between in class and out of class work. They recommend in class work when it requires the teacher and/or other students to complete. Outside class work involves what the student can do alone.

Cooperative learning is an excellent strategy that enhances student learning. In cooperative learning, students work in pairs or small groups to help each other. Learning increases if the groups have a common goal that they can only achieve if all group members do well on independent learning. In other words, students have to teach each other, because their own success depends on it. *(Educational Research, n.d.)*

> The goal for the teacher is to allow settings where students work collaboratively but understand that they are tested independently.
>
> *(STEPS Faculty)*

With collaborative work, the teacher must ensure that each student has a specific responsibility and that they are each responsible individually as well as for others in their group. One teacher recommends to not reveal the reporter until the group has completed its work.



# Academic Integrity

Academic integrity includes values such as honesty, trust, and fairness that allow one to avoid cheating or plagiarism.

For mathematics and science, academic integrity is much about the student's journey of struggling through rich, difficult content conforming to group input when the teacher allows such and working individually when the assignment requires such. It also includes determining credible sources and citing them correctly.

**Importance of Academic Integrity**
Like so many of the other Cross-Disciplinary Skills, integrity is disposition; we are to take responsibility and be honest.

**Connecting Academic Integrity to the College and Career Readiness Standards**
The Cross-Disciplinary Standards focus on students being able to attribute ideas to source material, evaluate sources, and adhere to an ethical code of conduct. Learn more about the state's alignment team's listing of performance examples for this standard.

## Academic Integrity

Our STEPS teachers and faculty advise that the best strategy for students to learn about academic integrity is for the teacher to consistently model it and hold students to a high level of expectation. For example, when the teacher presents information, he/she can cite sources from which information was obtained and why the source must be documented.

Second, there is no substitute for a rich classroom discussion about what is academic integrity and why it matters. It not only sets the stage for your expectations, but also provides an opportunity for the student to reflect on their values. The teacher may want to use real-world examples of people in the workplace who have violated an ethical code of conduct and the consequences to them individually as well as to others. A resource for ideas for classroom discussions can be found at 50 Ways to Jumpstart Academic Integrity Discussion in Your Class.

Our STEPS faculty recommend that even minor violations should be brought to the attention of the student so they are not enabled to continue with more serious violations. They recommend providing opportunities for group work assigning specific duties to every person in the group.

# Final Thoughts on Key Cognitive Skills

As a classroom teacher, reflect upon your deliberate behaviors to

- enhance your students' curiosity for deeper understanding;
- continuously expect students to explain their lines of reasoning;
- teach your students to evaluate their own data; and
- expect students to employ multiple strategies.


# Foundational Skills

# Exploring the Foundational Skills

According to the Educational Policy Improvement Center in the College and Career Readiness booklet, "Foundational skills consist of proficiencies students need to be able to transfer knowledge and apply it across the curriculum."

*(EPIC, 2008, p. 30)*

**Reading Across the Curriculum**

For science, reading often involves technical and scientific articles. This would certainly include recognizing and understanding the technical vocabulary. For mathematics, the student must translate the English language to a language of mathematics by making mental or physical images. Students must be able to utilize pre-reading strategies, such as activating their prior knowledge; utilize during reading strategies, such as mental imagery, re-reading, and self-questioning; and post-reading strategies, such as summarizing major points as well as organizing concepts from their readings.

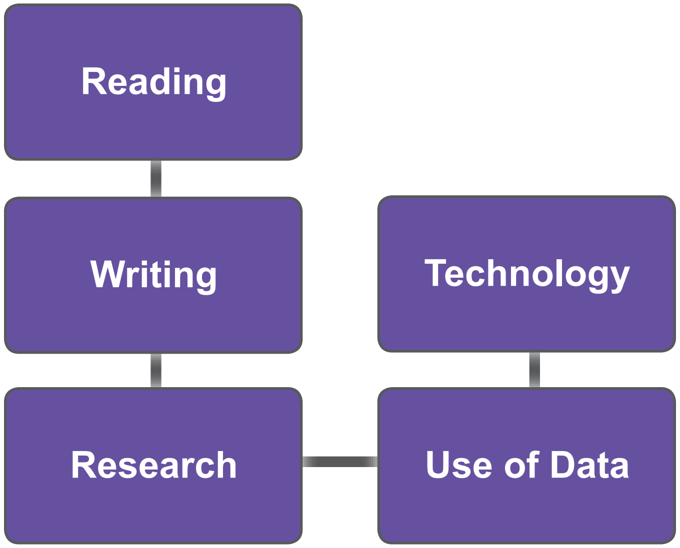



Figure 4

# Exploring the Foundational Skills

**Importance of Reading in Mathematics and Science**

As the Cross-Disciplinary Standards suggest, reading skills for mathematics and science are foundational; it allows the student to accurately determine what the problem requires.

The importance of the teacher understanding reading in mathematics and science is to provide reading strategies that enable a student to approach expository text. Students must persevere by reading and re-reading problems several times to extract the details. Our STEPS teachers suggest that many students find biology difficult because it is largely technical reading.

**Connecting Reading to the College and Career Readiness Standards**

The CCRS address reading as the student's ability to apply multiple strategies to extract and process meaning from the written word. Learn more about the state's alignment team's listing of performance examples for this standard.

## Reading

The STEPS team has produced an entire staff development module on Independent Reading Practices for Mathematics and Science Students. See that module for extensive reading strategies for math and science classrooms.

Learn more about Independent Reading Practices for Mathematics and Science Students.

# Writing Across the Curriculum

Writing is an important foundational skill for both science and mathematics. For science, students should be able to present scientific and technical information in appropriate formats. Such formats might include narrative, numerical, graphic, pictorial, and/or symbolic. In addition, they are expected to utilize vocabulary terms correctly and in context *(EPIC, 2008)*. According to the Educational Policy Improvement Center in the College and Career Readiness Standards booklet, “For mathematics students must be able to understand that certain symbols have multiple meaning and communicate them accurately. They are required to communicate mathematics ideas using symbols, construct and use graphic organizers, and explain reasoning in both oral and written form using notations, terminology, and logic” *(EPIC, 2008, p. a21)*.

# Writing Across the Curriculum

**Importance of Writing in Mathematics and Science**
The process of writing requires gathering, organizing, and clarifying thoughts. Writing represents one's understanding of a topic or concept. Writing and communication are so important to mathematics and science that it is addressed in a stand alone mathematics Standard, IX. Communication and Representation and combined with reading in the Science Standard, III. Foundation Skills: Scientific Applications of Communication.

**Connecting Writing to the College and Career Readiness Standards**
The CCRS address writing as the student's ability to write in a variety of formats in a clear concise manner. Learn more about the state's alignment team's listing of performance examples for this standard.

## Writing Across the Curriculum

STEPS science teachers utilize interactive notebooks as a vehicle for students to analyze and process learned material. An example is provided below.

There are any numbers of sites that provide information and instructions for using interactive notebooks in the classroom. One such site Slide Share provides rich examples.

One example used by our STEPS biology teachers is noted in Figure 6.

| Reflective Question | Topic |
|---|---|
| Student responds to reflective question provided by the teacher.<br><br>example: Explain one way you think natural selection shapes future populations of organisms. | Student takes notes on the right hand side.<br><br>example topic: evolution |

Figure 6

# Mathematics Example: Writing Across the Curriculum

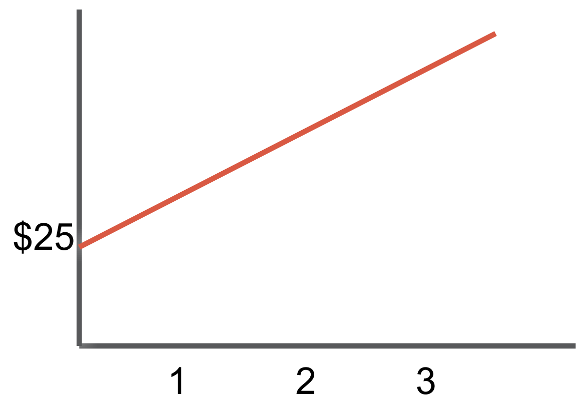
## Content Objective: Linear Functions

Dan has $25 in savings. He will be saving $5 a week.

- Have student complete multiple representations.
- Suppose that Dan's savings changes to $35. How would this change the table, graph, and function rule?
- Complete the new multiple representations.
- Explain in writing what changes and why it changes.

$$F(x) = 25 + 5x$$

| X | Y |
|---|---|
| 0 | 25 |
| 1 | 30 |
| 2 | 35 |




*(STEPS HS mathematics teachers)*

Learn more about the Cross-Disciplinary Standards' connection to this example.

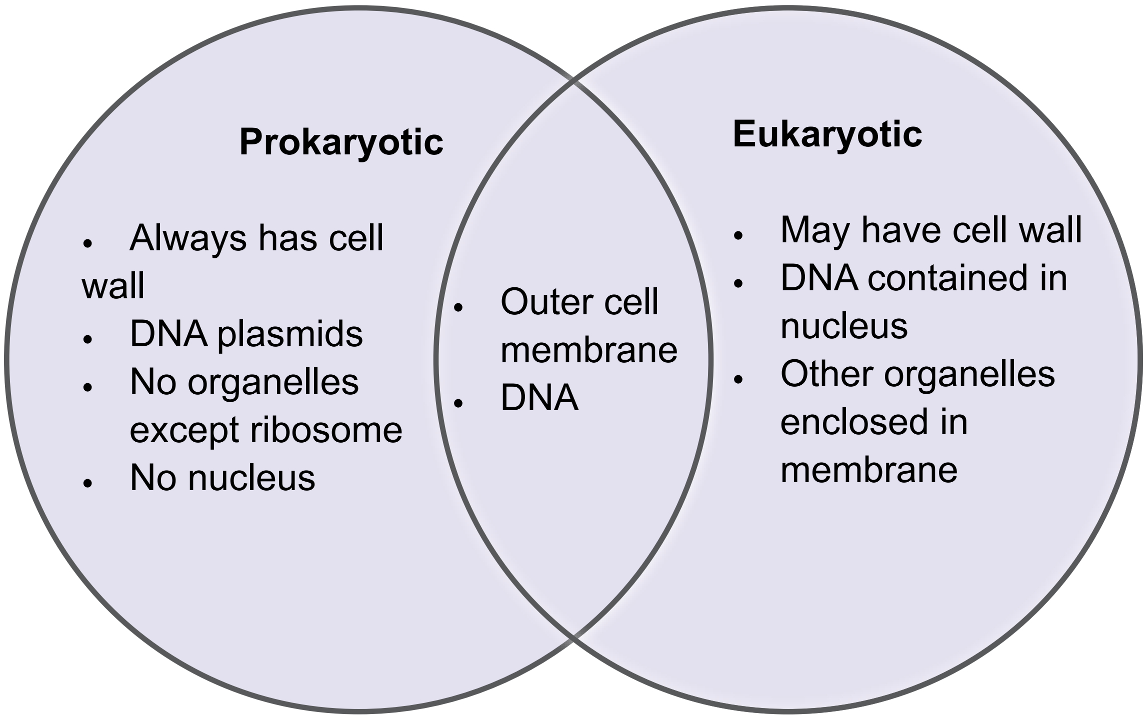
# Science Example: Writing Across the Curriculum

## Content Objective: Cells

Science writing is much different than what a student pursues in the English class. For science, the writing should be precise with minimal elaboration and organized in a way to show relationships.

Below is an example of an interactive notebook entry for a lesson on organelle cells.

**Organelles Reflection**




| Organelles Notes | P | E |
|---|---|---|
| Plasma membrane-outermost all surface composed of protein and lipids, especially phospholipids | X | X |
| Cytoplasm- semi liquid substance that compose foundation of cells | X | X |
| Organelles-membranes bound bodies that provide specialized function | | X |
| Endoplasmic reticulum-series of membranes extending through cytoplasm, rough studded with ribosome<br>smooth- no ribosome | | X |

*(STEPS HS biology teachers)*

Learn more about the Cross-Disciplinary Standards' connection to this example.

# Research Across the Curriculum

Although the term 'research' is used to describe a systematic process to answer a question or solve a problem, for mathematics and science, research involves identifying all possible sources to address a problem, collecting the correct information, and choosing credible sources. Science addresses research through a science standard Research Skills/Information Literacy.  Synthesis is a critical part of this process as one takes all of the gathered information  identifying  the best possible solution.

**Importance of Research in Mathematics and Science**

Research is foundational to mathematics and science because while both disciplines work for the correct answer, they are more concerned about the process. To collect and analyze data in subjects such as science and mathematics, the basic methodology involved in completing research involves the same processes that humans use on a daily basis to answer questions and solve problems. Hence the importance for students to develop a deep understanding of this process in preparation for real-world application.

**Connecting Research to the College and Career Readiness Standards**

The CCRS address research as the student's ability to formulate the question, plan a study, evaluate and synthesize information, and present a product. Learn more about the state's alignment team's listing of performance examples for this standard.

## Research

Our STEPS science teachers suggest that there are three stages to research in science:

**Initial Stage:**
Identify what is already known about the question or problem.

**The Investigative Stage:**
Conduct an experiment and collect data.

**Data Analysis and Discussion stage:**
Analyze and compare information to prior discoveries which may trigger additional research.

Our STEPS mathematics teachers suggest that research includes students communicating mathematically: reading mathematics, describing their thinking, writing definitions and conjectures, using symbols, and justifying their conclusions.

Ken Levasseur provides further explanation for Research in the Mathematics Classroom and a Graphic Organizer representing the phases.

"In science, alert your students that there is not always a right or wrong answer. They must, however, be able to defend their findings."

*(STEPS biology teachers)*

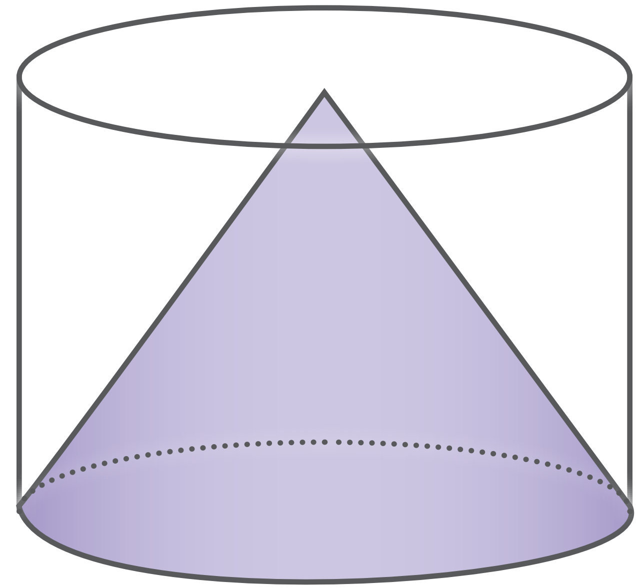
# Mathematics Example: Research

## Content Objective: Volume Measurement

**Volume of a Cone**

Knowing that a cone is 1/3 volume of a cylinder, the students are to:

- Create smallest cylinder that contains the cone
- Cut the cone in 2 pieces of equal heights
- Create smallest cylinder that will contain each piece of the cone
- Calculate the volume of each of these cylinders
- Repeat the process with each piece
  (the more you do, the more you will see patterning).



*(STEPS HS geometry teachers)*

You must investigate to solve the problem. Looking at the pattern, what is your conclusion? How does the volume of the 2 pieces compare to the volume of the original? Why?

Learn more about the Cross-Disciplinary Standards' connection to this example.

# Science Example: Research

## Content Objective: Genetics

Students sometimes struggle with digesting the scientific concepts learned in class and applying that knowledge to real-world situations. Encourage students to apply their learning by requiring them to formulate opinions on ethical issues. This process will require the students to use research, reasoning, and problem-solving skills.

The basic concept behind genetic engineering involves the process of removing a functional DNA fragment - a gene - from one organism and combining it with the DNA of another organism in order to make the protein that the gene codes for. For example, currently some plants are genetically engineered to acquire genes for resistance to pests or diseases. Also, in the cases of gene therapy for humans, functional genes can be given to people with non-functional or mutated genes, such as in a genetic disease like cystic fibrosis.

*(Woden HS Biology teacher)*

Students are asked to research the following:

- Are applications of genetic engineering ethical?
- Students identify key vocabulary related to genetic engineering.
- Students organize their information related to the topic.
- Students express their opinion in an outline.
- Students produce a positional essay that reflects their opinion of the ethics of genetic engineering.

Students express in a written summary their understating of the process of genetic engineering using appropriate terminology. Students should include several scenarios of how genetic engineering is used to solve a problem. Students take a position on genetic engineering and cite reasons for their position. Students argue the other position.

Learn more about the Cross-Disciplinary Standards' connection to this example.

# Use of Data

For students to be able to use data in mathematics and science, they must be able to collect information, analyze it, and draw conclusions from it. They must be able to recognize patterns, create data in multiple formats (graphing, tables, etc.), and use it accurately and precisely to derive a conclusion.

**Importance of Use of Data**

The foundation for mathematics and science is data; students must continuously use data to build their knowledge.

**Connecting Use of Data to the College and Career Readiness Standards**

In the Cross-Disciplinary Standards, use of data entails identifying patterns, using statistical and probability skills necessary to plan an investigation, collecting, analyzing, and interpreting data, and communicating and presenting data in a variety of formats. Learn more about the state's alignment team's listing of performance examples for this standard.

## Use of Data

- In lieu of handing out organized data, have students create and organize their own data.
- Implement an inquiry based learning environment.
- Teach students to understand what is irrelevant in their own data, what to do with outliers, and when something can be eliminated.
- Have students process more than one set of data to understand reasonableness, to look for patterns, etc.
- Have students see the relationships in data.

> *"Not only must we teach students to use data, our expectations must also portray that data that they use must be accurate and precise."*
>
> *(STEPS chemistry teachers)*

# Mathematics Example: Use of Data

## Content Objective: Functions

**What Question Can We Answer with Data**

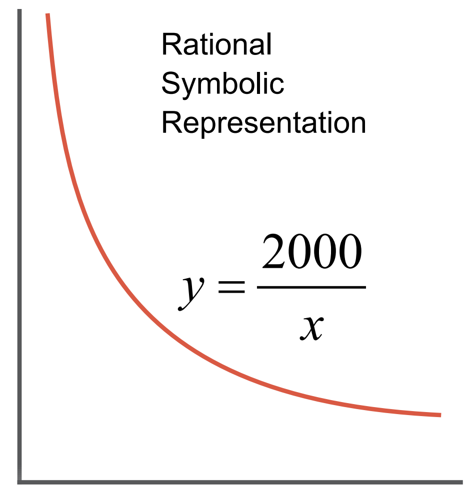
Jason is being paid $2,000 to prepare a sales report for the president of a major oil company to be presented to the stockholders. Because of a limited timeline, Jason must hire additional people to help complete the report. He will share the fee equally among all persons that work on the report, and he does not want to exceed 10 people.

What is the relationship between the amount each person will receive and the number of persons working on the report?

The student is to

- construct a table of at least eight values;
- sketch a graph with axes appropriately scaled and labeled for the problem situation;
- give the representative parent function;
- determine a symbolic representation for the problem situation; and
- compare and contrast the domain and range for the function and for the problem situation.

| # of persons (x) | Amt. Paid per Person (y) |
|---|---|
| 1 | 2000 |
| 2 | 1000 |
| 3 | 666.67 |
| 4 | 500 |
| 5 | 400 |
| 6 | 333.33 |
| 7 | 285.71 |
| 8 | 250 |




*(Hudson HS Algebra teacher)*

Learn more about the Cross-Disciplinary Standards' connection to this example.

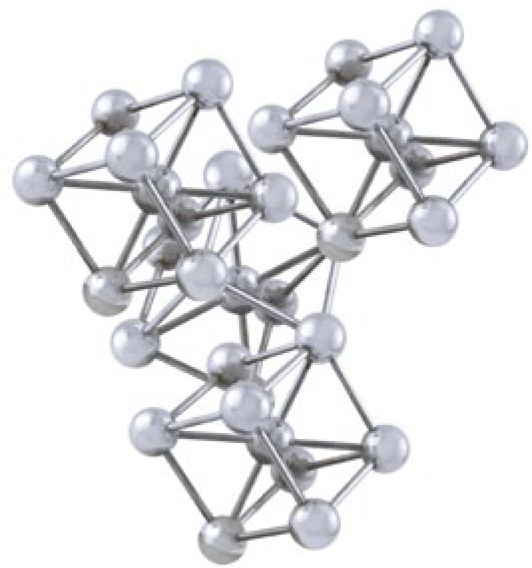
# Science Example: Use of Data

## Content Objective: Thermochemistry

**Thinking About What You Need**

After students have explored application of the Law of Conservation of Energy, they are asked to devise a plan to determine the specific heat of a metal (unknown). Students must present a plan that outlines the following:

- Steps in process that supports Law of Conservation of Energy, including a visual representation of procedure
- All materials and equipment necessary
- All safety concerns
- Specific data that must be collected
- Organized data table
- Sample calculations using data



Once a plan is approved by the instructor, students carry out procedure, collect, organize, and analyze data. Students then report findings.

*(Hudson HS Chemistry teacher)*

Learn more about the Cross-Disciplinary Standards' connection to this example.

# Technology

For science, the student must be adept in computer literacy with command of word processing, spreadsheets, data gathering probes, tools, lab equipment, peripheral equipment, simulations, and computer models-all with the intent to describe, analyze, and synthesize data.

**Importance of Technology**

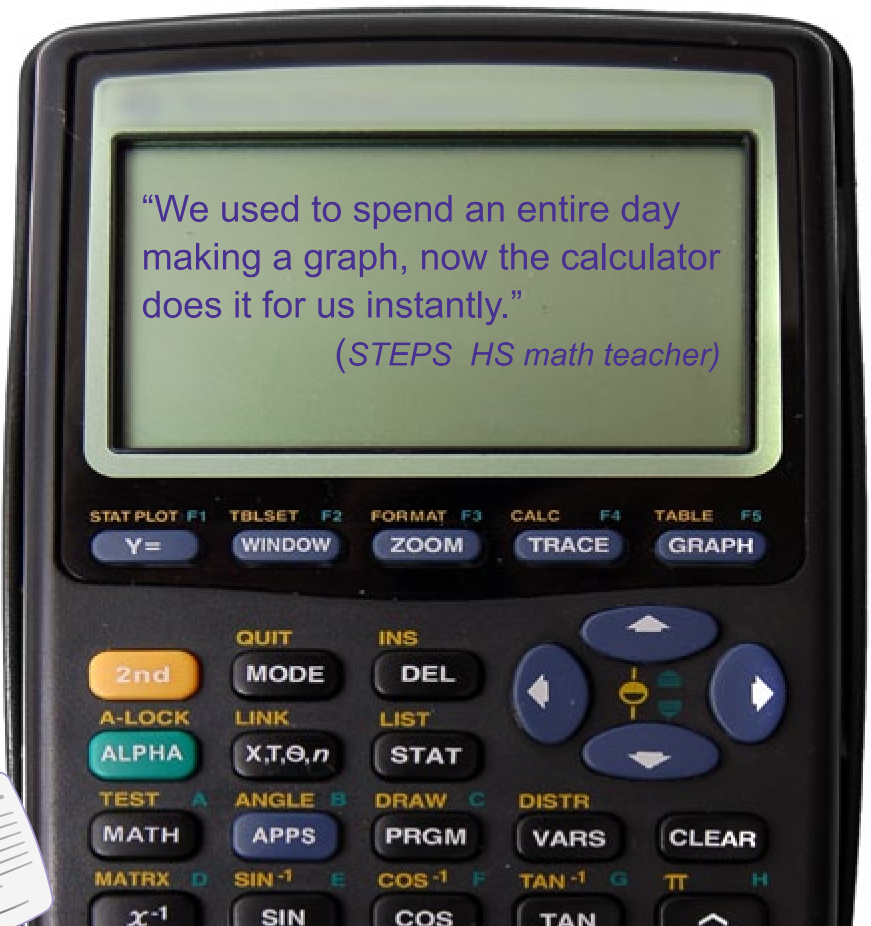
In mathematics and science, technology provides tools for extensive accuracy of data as well as an economic value with quick analysis of data. It provides an opportunity for 'real time' data. Certainly, technology provides valuable visual and organizational tools for student learning.

**Connecting Technology to the College and Career Readiness Standards**

The Cross-Disciplinary Standards specify that students must use technology not only to gather but also to organize, manage, analyze, and communicate information. Learn more about the state's alignment team's listing of performance examples for this standard.

## Technology

Use the calculator as a tool. Teach the process, not just steps. The student must understand the thought processes inherent in the operations. Why did it occur?




# Mathematics Example: Use of Data

## Content Objective: Objective

The STEPS faculty and teachers often discuss the use of the calculator in the mathematics classroom. They both agree that while the calculator is a valuable tool for manipulating data, the pre-service teacher should expect students to learn the process behind the calculator function. The graphing calculator can be used to find the maximum or minimum of a quadratic function.

Below is one such example.
Finding the vertex of a quadratic function can be done with or without the use of a calculator.

$$f(x) = 2x^2 - 4x + 5$$

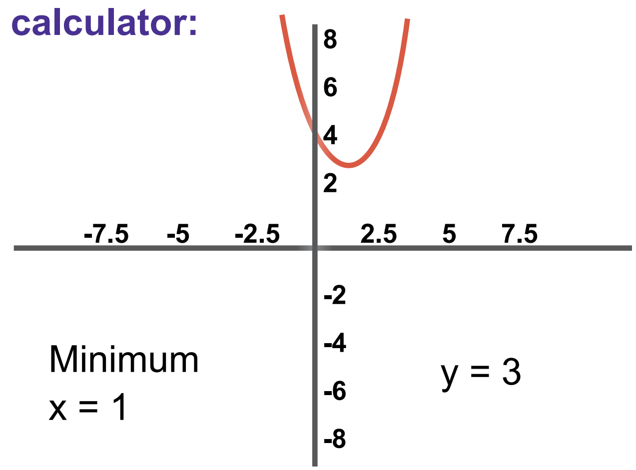
Below we show how to find the vertex of a parabola without a calculator and also provide a screen shot of a calculator image of the same quadratic function with its minimum pint indentified.

**Without the calculator:**

Use the formula $x = -\frac{b}{2a}$ to find the x-coordinate of the vertex.

| | |
|---|---|
| $x = -\frac{(-4)}{2(2)} = \frac{4}{4} = 1$ | The x-coordinate of the vertex is 1. Evaluating the function at 1 gives the y-coordinate of the vertex. |
| f(1)=3 | The vertex of the quadratic function is (1,3). |

**With a calculator:**




*(Lufkin HS algebra teacher)*

Learn more about the Cross-Disciplinary Standards' connection to this example.

# Science Example: Technology

## Content Objective: Population trends

**Analyzing Data in Amphibian Population Trends**
Over the past several decades, scientists have reported changes in amphibian populations worldwide. In 2010, a team of researchers collected and analyzed studies from nine countries. Use their data to answer the following questions.

| Region | # Amphibian Population Increasing | # Amphibian Population Decreasing | No Amphibian Population Change |
|---|---|---|---|
| Western Europe | 248 | 309 | 29 |
| Africa/Middle East | 2 | 2 | 1 |
| Eastern Europe | 5 | 4 | 0 |
| North America | 96 | 130 | 14 |
| South America | 19 | 31 | 1 |
| Australia/NZ | 6 | 17 | 1 |
| Asia | 10 | 10 | 1 |

**Use the Data:**

- Construct a graph displaying the declining populations as percentages. Which type of graph did you choose? Explain why.
- What percentage of worldwide amphibian population is declining?
- Does the data indicate a trend? If so, predict an outcome for thirty years from now.

Learn more about the Cross-Disciplinary Standards' connection to this example.

# Final Thoughts on Key Cognitive Skills

As in-service and pre-service teachers,

- What are some ways that you can incorporate the foundational skills into your content area?
- What are some ways that you can heighten your students appreciation of and value for the foundational skills to their future success?


# Embedding Cross-Disciplinary in Lesson Design

# Lesson Design

Although there are a variety of instructional lesson designs, the backwards design model by Wiggins and McTighe *(1998, 2006, 2008, & 2011)* focuses on what students should know and be able to do by the end of the lesson/unit. This idea drives the entire lesson design. As a result, the model begins with identifying the desired results and then "works backwards" to develop the types of assessment and, finally, the instructional strategies. This model differs from traditional approaches which begin with defining what topics need to be covered and then decide upon the assessment at the end of instruction.

The backwards design model incorporates three main steps in this plan; however, that model has been expanded in this version to include a step for increasing the rigor of the lesson by incorporating the appropriate Cross-Disciplinary Standards.

**Identify Desired Results**

- What should the student know, understand, and be able to do?

↓

**Determine Acceptable Evidence**

- How will we know if students have achieved the desired results and met the standards?
- What will we accept as evidence of student understanding?

↓

**Plan Learning Experience**

- What activities will equip students with the needed knowledge and skills?
- What will need to be taught and coached, and how should it best be taught in light of performance goals?
- What materials and resources are best suited to accomplish these goals?

# Adapted Backwards Design Model

## 1 Content Skills and Objectives

Identify what students should know and be able to do by the end of the lesson/unit by locating the relevant topic/skill standard in the TEKS, the CCRS, and the ELPS standards, taking note of the cognitive level of the verb in each statement. See Table 1 for an example.

You may follow the standards links in Figure10.

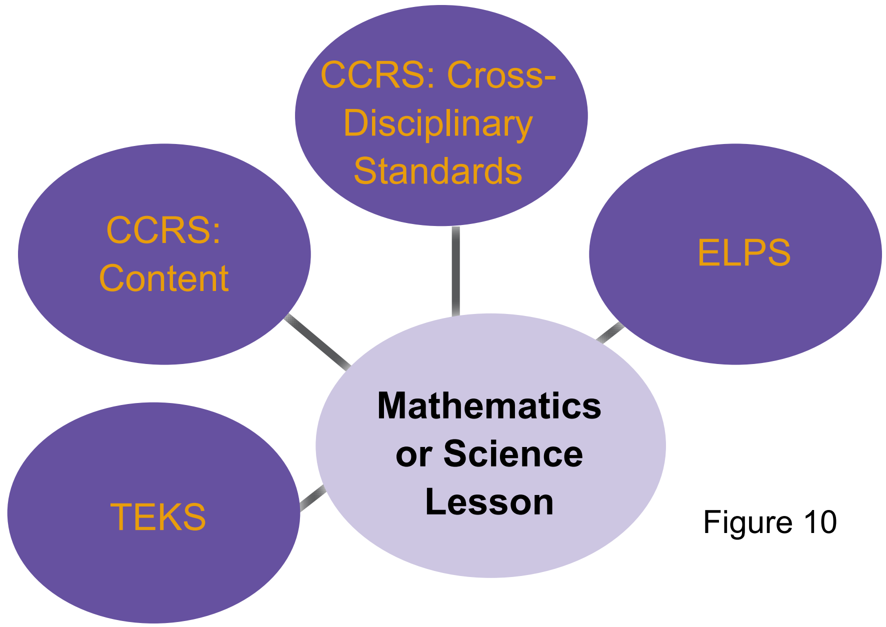



Figure 10

| Examples of objectives from all four standards that use similar verbs TEKS in Biology | Action Verbs |
|---|---|
| TEK 2(E) : Plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology. | Plan, formulating testable hypothesis |
| CCRS Science: IB Design and conduct scientific investigations in which hypotheses are formulated and tested. | Design, hypothesis formulated and tested |
| Cross -Disciplinary: IIC. Research across the curriculum (to formulate research questions, propose testable hypotheses) | Research; propose testable hypothesis |
| ELPS: 4(J) demonstrate English comprehension and expand reading skills by employing inferential skills such as predicting, making connections between ideas, drawing inferences and conclusions from text and graphic sources, and finding supporting text evidence commensurate with content area needs | Predict |

Table 1

## 2 Increase Rigor by using the Cross-Disciplinary Standards to develop student skills

Table 2 represents a resource chart of core lesson components. The chart is organized by cognitive and foundational skills. Use Table 2 as a resource guide to incorporate the Cross-Disciplinary Standards into a lesson.

| Core Components | Skills | | | | | | |
|---|---|---|---|---|---|---|---|
| | Cognitive Skills | Academic Behaviors | Work Habits | Academic Integrity | Reading | Writing Skills | Technology |
| Problem/Hypothesis Formulation | | | | | | | |
| Planning & Research | | | | | | | |
| Reasoning & Interpretation | | | | | | | |
| Constructing & Presenting Results | | | | | | | |

Table 2

**Resource Chart with Student Performance Expectations:**
**Using the Cross-Disciplinary Standards to Develop Student Skills**

The following chart indicates the appropriate student performance expectations for each of the core components listed on the left as well as the cognitive and foundational skill categories listed across the top of the chart. For each performance expectation there are also examples of student performance indicators listed on pages a59-a65 of the CCRS Cross-Disciplinary guide.

Resource Chart of Core Components Organized by Cognitive and Foundational Skills

| Core Components | Skills | | | | | | |
|---|---|---|---|---|---|---|---|
| | Performance Expectations for Cognitive Skills | Performance Expectations for Academic Behaviors | Performance Expectations Work Habits | Performance Expectations Academic Integrity | Performance Expectations for Reading Skills | Performance Expectations for Writing Skills | Performance Expectations for Technology Skills |
| Problem/Hypothesis Formulation | I.A II.C<br>I.C<br>I.D | I.D | I.E | I.F | II.A | II.B<br>II.C | II.E |
| Planning & Research | I.A II.C<br>I.B<br>I.C<br>I.D | I.D | I.E | I.F | II.A | II.B | II.E |
| Reasoning & Interpretation | I.A II.C<br>I.B<br>I.C<br>I.D | I.D | I.B<br>I.E | I.F | II.A | II.B | II.E |
| Constructing & Presenting Results | I.A II.C<br>I.B II.D | I.D | I.E | I.F | II.A | II.B | II.E |

Table 2

## 3 Assessment

Determine what constitutes acceptable evidence of student competency in the identified TEKS, CCRS, and ELPS standards. In the Cross-Disciplinary Standards, the student performance indicators provide a guide to competency. Then use the information and models from the Assessment Module to design an appropriate assessment that will measure relevant standards and objectives at the same or higher cognitive level of the verb in each standard and performance indicator.

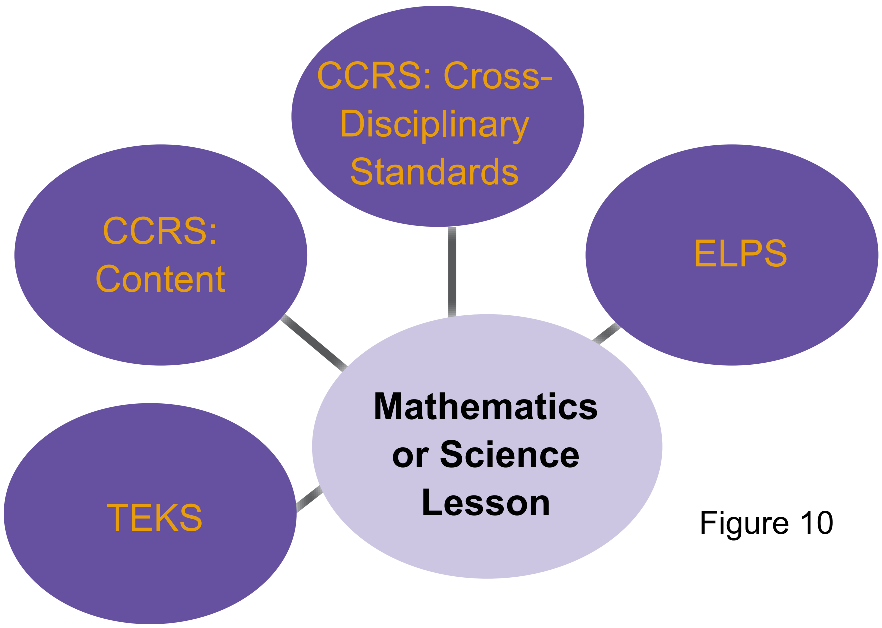
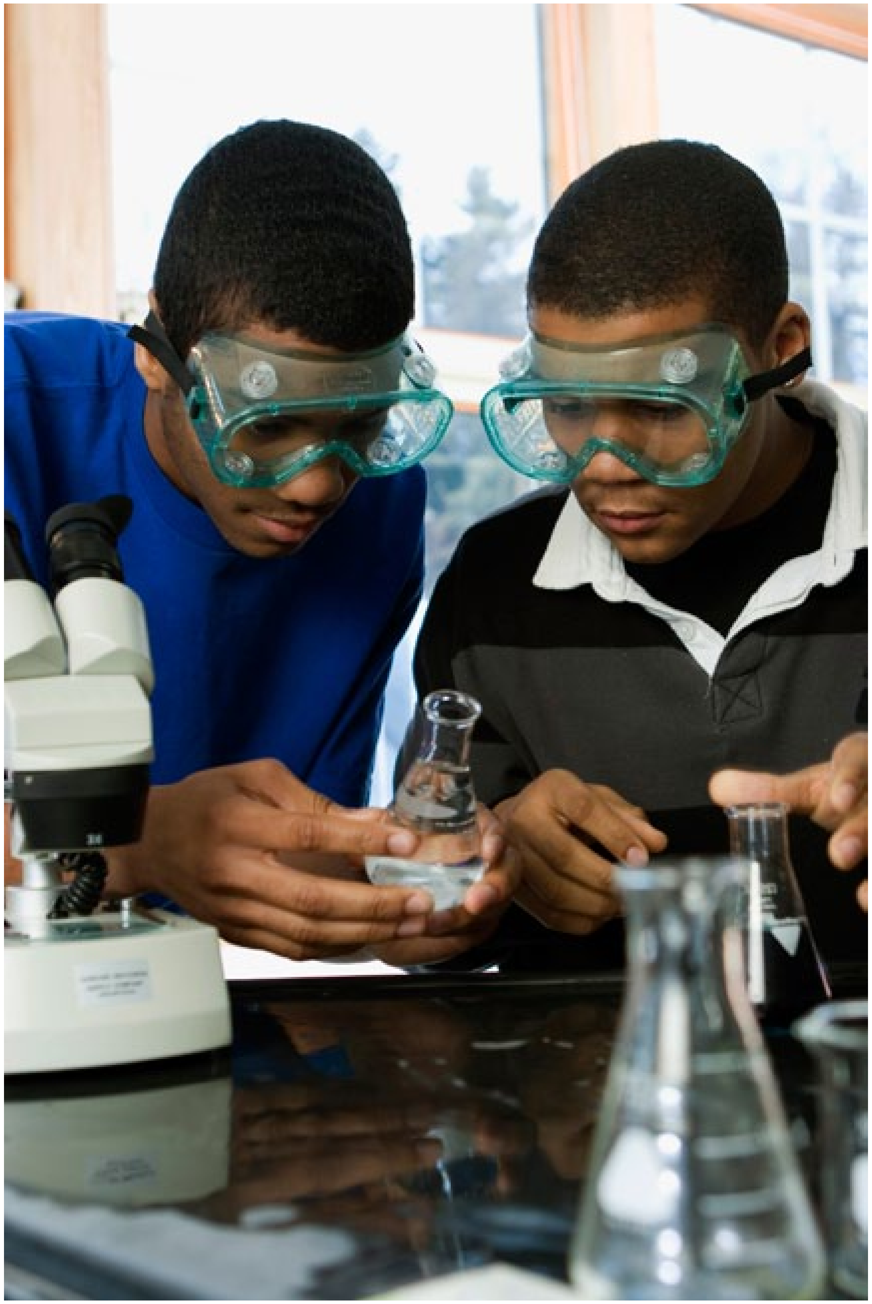
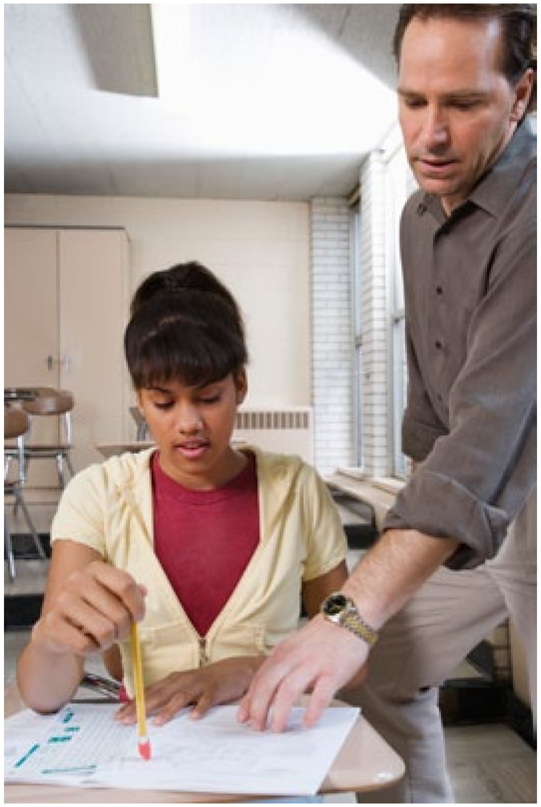



Figure 10



Plan instructional strategies and learning activities that will bring students to these competency levels using suggestions from the Instruction Module.



# Final Thoughts on Lesson Design

As in-service and pre-service math and/or science teachers, managing your curriculum not only includes a scope and sequence of content but also a systematic inclusion of the Cross-Disciplinary Standards as well.

# Closing Remarks

The STEPS team commends you as you have voluntarily pursued this module as one resource to enhance your understanding of the Cross-Disciplinary Standards.

As we have assimilated the Cross-Disciplinary Standards, we understand that we must not only review our classroom instruction as a method for our students to gain content knowledge, but also a critical environment where we can prepare our students to thrive in a new global economy. Incorporating the Cross-Disciplinary Standards into our practice will prepare our students to work collaboratively, synthesize information, communicate, solve complex problems, and create new knowledge.

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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*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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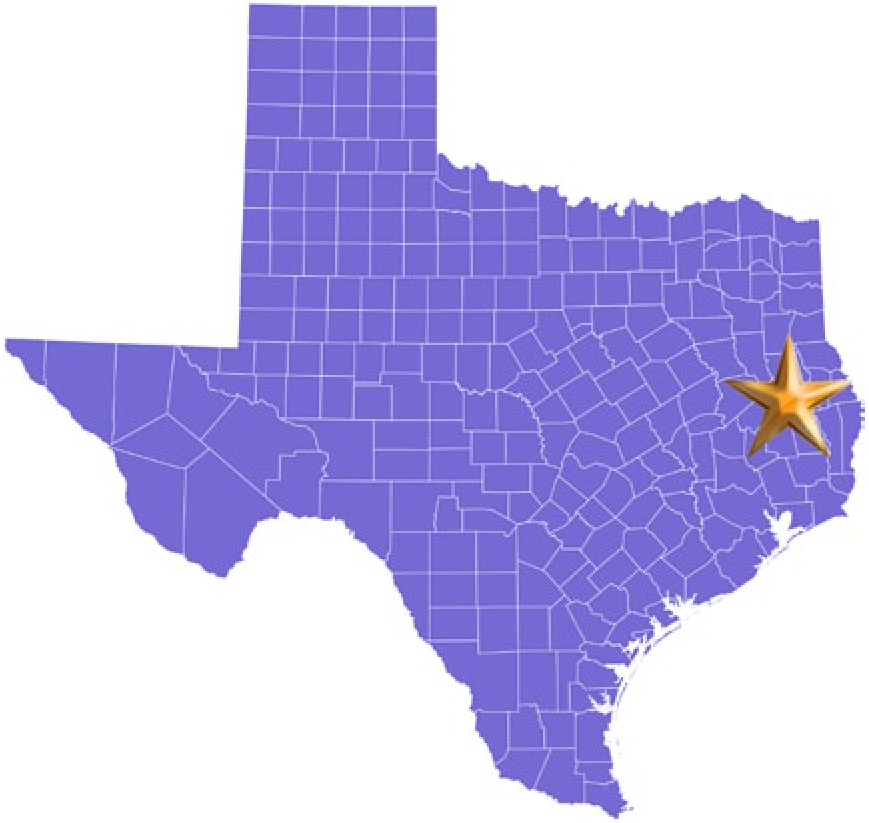

# Supporting Information

# Communication and Representation

Return

| IX. Communication and Representation |
|---|
| **A. Make connections between geometry and algebra.**<br>1. Use mathematical symbols, terminology, and notation to represent given and unknown information in a problem.<br>2. Use mathematical language to represent and communicate the mathematical concepts in a problem.<br>3. Use mathematical as a language for reasoning, problem solving, making connections, and generalizing.<br><br>**B. Interpretation of mathematical work**<br>1. Model and interpret mathematical ideas and concepts using multiple representations.<br>2. Summarize and interpret mathematical information provided orally, visually, or in written form within the given context.<br><br>**C. Presentation and representation of mathematical work**<br>1. Communicate mathematical ideas, reasoning, and their implications using symbols, diagrams, graphs, and words.<br>2. Create and use representations to organize, record, and communicate mathematical ideas.<br>3. Explain, display, or justify mathematical ideas and arguments using precise mathematical language in written or oral communications.<br><br>*(EPIC, 2008 p. 11)* |

# Scientific Applications of Communication

Return

| III. Foundation Skills: Scientific Applications of Communication |
| --- |
| **A. Scientific writing**<br>1. Use correct applications of writing practices in scientific communication.<br><br>**C. Presentation of scientific/technical information**<br>1. Prepare and present scientific/technical information in appropriate formats for various audiences.<br><br>*(EPIC, 2008 p. a28-a29)* |

# Scientific Applications of Communication

Return

| III. Foundation Skills: Scientific Applications of Communication |
| --- |
| **A. Scientific writing**<br>1. Use correct applications of writing practices in scientific communication.<br><br>**C. Presentation of scientific/technical information**<br>1. Prepare and present scientific/technical information in appropriate formats for various audiences.<br><br>*(EPIC, 2008 p. a28-a29)* |

# Scientific Applications of Communication

Return

| III. Foundation Skills: Scientific Applications of Communication |
|---|
| **D. Research skills/information literacy**<br>1. Use search engines, databases, and other digital electronic tools effectively to locate information.<br>2. Evaluate quality, accuracy, completeness, reliability, and currency of information from any source.<br>*(EPIC, 2008 p. a29)* |

# Cross-Disciplinary Standards

Return

| I. Key Cognitive Skills |
|---|
| A. Intellectual curiosity, Performance examples |
| **1. Engage in scholarly inquiry and dialogue.**<br>a. Identify what is known, not known, and what one wants to know in a problem.<br>b. Conduct investigations and observations.<br>c. Cite examples or illustrations in which a clear-cut answer cannot be reached.<br>**2. Accept constructive criticism and revise personal views when valid evidence warrants.**<br>a. Articulate a point of view and provide valid evidence to support findings.<br>b. Demonstrate willingness to take intellectual risks by investigating novel, controversial, or unpopular opinions or conclusions.<br>c. Examine alternative points of view, taking different roles to defend, oppose, and remain neutral on issues.<br>d. Recognize conflicting information or unexplained phenomena.<br>*(EPIC, 2008 p. a59)* |

# Cross-Disciplinary Standards

Return

| I. Key Cognitive Skills |
|---|
| B. Reasoning, Performance examples |

**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)*

# Cross-Disciplinary Standards

Return

| I. Key Cognitive Skills |
|---|
| C. Problem Solving, Performance examples |
| **1. Analyze a situation to identify a problem to be solved.**<br>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.<br>b. Break complex problems into component parts that can be analyzed and solved separately.<br>c. Apply previously learned knowledge to new situations.<br>d. Analyze a media report, identify any misuse of statistics, and suggest ways to more accurately depict this information.<br>**2. Develop and apply multiple strategies to solve a problem.**<br>a. Use a range of standard methods, devices, techniques, and strategies to gather and analyze information.<br>b. Use knowledge gained from other subject areas to solve a given problem.<br>**3. Collect evidence and data systematically and directly relate to solving a problem.**<br>a. Use general and specialized reference works and databases to locate sources.<br>b. Collect evidence and data directly related to solving the problem and eliminate irrelevant information.<br>c. Produce charts, graphs, and diagrams accurately, including scale, labeling, units, and organization.<br>d. Present the collected data visually, describe the data collection procedure, and defend choosing that procedure over other possibilities.<br><br>*(EPIC, 2008, p 59)* |

# Cross-Disciplinary Standards

Return

| I. Key Cognitive Skills |
|---|
| D. Academic Behaviors, Performance examples |
| **1. Self monitor learning needs.**<br>a. Ask questions to check for understanding or to clarify information.<br>b. Use a systematic method for recording, storing, and organizing materials and resources; avoid haphazard or messy accumulation of information.<br>**2. Use study habits necessary to manage academic pursuits and requirements.**<br>a. Manage time effectively to complete tasks on time.<br>b. Demonstrate accurate note-taking.<br>c. Use the appropriate level of detail necessary to complete an assigned task.<br>d. Balance academic and non-academic activities to successfully participate in both.<br>**3. Strive for accuracy and precision.**<br>a. Collect and report experimental data carefully and correctly.<br>b. Produce charts, graphs, and diagrams accurately, including scale, labeling, units, and organization.<br>c. Eliminate irrelevant information from an assignment.<br>**4. Persevere to complete and master tasks.**<br>a. Persevere until a task is completed by working even when faced with uncertainty or open-ended assignments.<br>b. Seek assistance when needed to complete the assignment.<br>c. Recognize when a task is completed.<br><br>*(EPIC, 2008, p a60)* |

# Cross-Disciplinary Standards

Return

| I. Key Cognitive Skills |
|---|
| E. Work Habits, Performance examples |
| **1. Work independently.**<br>a. Plan a project, establish its parameters, and complete it with minimal supervision, seeking assistance accordingly.<br>b. Follow directions or procedures independently.<br>c. Complete assignments outside the classroom setting in a timely manner.<br>**2. Work collaboratively.**<br>a. Work collaboratively with students from various cultural and ethnic backgrounds.<br>b. Distinguish between situations where collaborative work is appropriate and where it is not.<br>c. Work in small groups to investigate a problem or conduct an experiment.<br>*(EPIC, 2008, p a60)* |

# Cross-Disciplinary Standards

Return

| I. Key Cognitive Skills |
|---|
| F. Academic Integrity, Performance examples |
| **1. Attribute ideas and information to source materials and people.**<br>a. Document the work of others, giving credit where credit is due and never claim credit for work that is not one's own.<br>b. Use standard bibliographic and reference citation formats, choosing the style appropriate to the subject and the audience.<br>c. Define plagiarism and articulate the consequences of academic dishonesty.<br>**2. Evaluate sources for quality of content, validity, credibility, and relevance.**<br>a. Verify validity of a source within a submitted work.<br>b. Compare and contrast coverage of a single topic from multiple media sources.<br>**3. Include the ideas of others and the complexities of the debate, issue, or problem.**<br>a. Present multiple perspectives of an issue.<br>b. Represent accurately the data, conclusions, or opinions of others.<br>**4. Understand and adhere to ethical codes of conduct.**<br>a. Follow copyright laws and restrictions.<br>b. Use technology responsibly (e.g., avoiding malice, misrepresentation, or misleading use of information).<br>*(EPIC, 2008, p a60)* |

# Cross-Disciplinary Standards

| II. Foundational Skills |
| --- |
| A. Reading Across the Curriculum, Performance examples |
| **1. Use effective pre-reading strategies.**<br>a. Use the title, knowledge of the author, and place of publication to make predictions about a text.<br>b. Use a table of contents to preview a text and understand its design.<br>c. Scan headline sections or other division markers, graphics, or sidebars to form an overview of a text.<br>**2. Use a variety of strategies to understand the meanings of new words.**<br>a. Use context clues, including definitions, examples, comparison, contrast, cause and effect, and details provided in surrounding text.<br>b. Consult references (e.g., dictionary, thesaurus) effectively.<br>c. Understand notation specific to discipline (e.g., mathematical notation, scientific symbols).<br>**3. Identify the intended purpose and audience of the text.**<br>a. Predict purpose and audience of a text based on the title, preface, and other features of a text.<br>b. Explain how the language of an effective text targets an intended audience.<br>c. Explain the importance of a technical and/or scientific article.<br>**4. Identify the key information and supporting details.**<br>a. Outline a chapter of an informational text.<br>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.<br>c. Analyze connections between major and minor ideas.<br>d. Identify and define key terminology from technical and/or scientific documents.<br>**5. Analyze textual information critically.**<br>a. Identify faulty premises in an argument.<br>b. Identify stated and implied assumptions.<br>c. Identify conclusions unsupported by sufficient evidence in informational texts.<br>d. Use inductive and deductive reasoning.<br>e. Draw conclusions based on evidence, support, or data through logical reasoning.<br>f. Compare a primary source and an interpretation in a textbook. |

Continued on next page...

# Cross-Disciplinary Standards

Return

| II. Foundational Skills |
|---|
| A. Reading Across the Curriculum, Performance examples |

**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 a61-62)*

# Cross-Disciplinary Standards

Return

| II. Foundational Skills |
|---|
| B. Writing across the curriculum, Performance examples |

**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

| II. Foundational Skills |
| --- |
| C. Research across the curriculum, Performance examples |

**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.

Continued on next page...

# Cross-Disciplinary Standards

Return

| II. Foundational Skills |
|---|
| C. Research across the curriculum, Performance examples |
| **4. Evaluate the validity and reliability of sources.**<br>a. State explicitly characteristics or identifying features that indicate accuracy or reliability of sources, to determine whether sources are biased, incomplete, or otherwise unreliable.<br>b. Follow a set of criteria to determine the validity and reliability of sources.<br>c. Identify claims found in one or more of the sources that require support or verification, and evaluate the information's validity.<br>d. Evaluate the data presented in graphics, tables, charts, and maps when appropriate to the topic.<br>**5. Synthesize and organize the information.**<br>a. Select quotations and evidence that support the thesis.<br>b. Determine what evidence best supports conclusions.<br>c. Use well-organized strategies to collect and organize information gathered.<br>d. Determine the best order for presenting evidence that supports conclusions.<br>**6. Design and present an effective product.**<br>a. Determine the best order for presenting major and minor points.<br>b. Design a report using features such as headings and graphics appropriate to the writing task.<br>c. Use a citation system specified by or appropriate to the assignment.<br>*(EPIC, 2008, p a63)* |

# Cross-Disciplinary Standards

Return

| II. Foundational Skills |
|---|
| D. Use of Data |
| **1. Identify patterns or departures from patterns among data.**<br>a. Identify patterns from multiple representations of data such as graphical and tabular forms.<br>b. Review current news events and evaluate possible connections (e.g., linking economic data with political events).<br>**2. Use statistical and probabilistic skills necessary for planning an investigation and collecting, analyzing, and interpreting data.**<br>a. Create representations of data (e.g., data tables, correctly labeled and scaled graphs, narrative descriptions).<br>b. Evaluate a given published report for missing information and misuse of data.<br>**3. Present analyzed data and communicate findings in a variety of formats.**<br>a. Compose a written document detailing a research project.<br>b. Use appropriate visuals and statistical results to convey findings to a specified audience.<br>*(EPIC, 2008 p. a64)* |

# Cross-Disciplinary Standards

Return

| II. Foundational Skills |
|---|
| E. Technology |
| **1. Use technology to gather information.**<br>a. Use the Internet or other appropriate technologies to post survey questions on an assigned topic.<br>b. Use devices to measure physical properties.<br>c. Use online databases to access scholarly work on an assigned research topic.<br>**2. Use technology to organize, manage, and analyze information.**<br>a. Use data analysis software to analyze survey results.<br>b. Use spreadsheets to manage and organize statistical data.<br>**3. Use technology to communicate and display findings in a clear and coherent manner.**<br>a. Create spreadsheets and graphs to communicate findings in a presentation that includes graphics, visuals, or other supporting images.<br>b. Utilize technology to present information and/or data in a variety of ways.<br>**4. Use technology appropriately.**<br>a. Explain how technology is a useful and effective tool to communicate findings.<br>b. Identify when technology may not be necessary or appropriate to communicate findings.<br>c. Formulate strategies to communicate findings with and without technology.<br>*(EPIC, 2008 p. a65)* |

# Cross-Disciplinary Standards

Return

| I. Key Cognitive Skills |
|---|
| C. Problem Solving, Performance examples |
| **1. Analyze a situation to identify a problem to be solved.**<br>**2. Develop and apply multiple strategies to solve a problem.**<br>**3. Collect evidence and data systematically and directly relate to solving a problem.**<br>*(EPIC, 2008, p 59)* |

# Cross-Disciplinary Standards

Return

| I. Key Cognitive Skills |
|---|
| D. Academic Behaviors, Performance examples |
| **1. Self monitor learning needs.**<br>a. Ask questions to check for understanding or to clarify information.<br>b. Use a systematic method for recording, storing, and organizing materials and resources; avoid haphazard or messy accumulation of information.<br>**2. Use study habits necessary to manage academic pursuits and requirements.**<br>a. Manage time effectively to complete tasks on time.<br>b. Demonstrate accurate note-taking.<br>c. Use the appropriate level of detail necessary to complete an assigned task.<br>d. Balance academic and non-academic activities to successfully participate in both.<br>**3. Strive for accuracy and precision.**<br>a. Collect and report experimental data carefully and correctly.<br>b. Produce charts, graphs, and diagrams accurately, including scale, labeling, units, and organization.<br>c. Eliminate irrelevant information from an assignment.<br>**4. Persevere to complete and master tasks.**<br>a. Persevere until a task is completed by working even when faced with uncertainty or open-ended assignments.<br>b. Seek assistance when needed to complete the assignment.<br>c. Recognize when a task is completed.<br>*(EPIC, 2008, p a60)* |

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| I. Key Cognitive Skills |
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# Cross-Disciplinary Standards

Return

| I. Key Cognitive Skills |
| --- |
| D. Academic Behaviors, Performance examples |

**1. Self monitor learning needs.**

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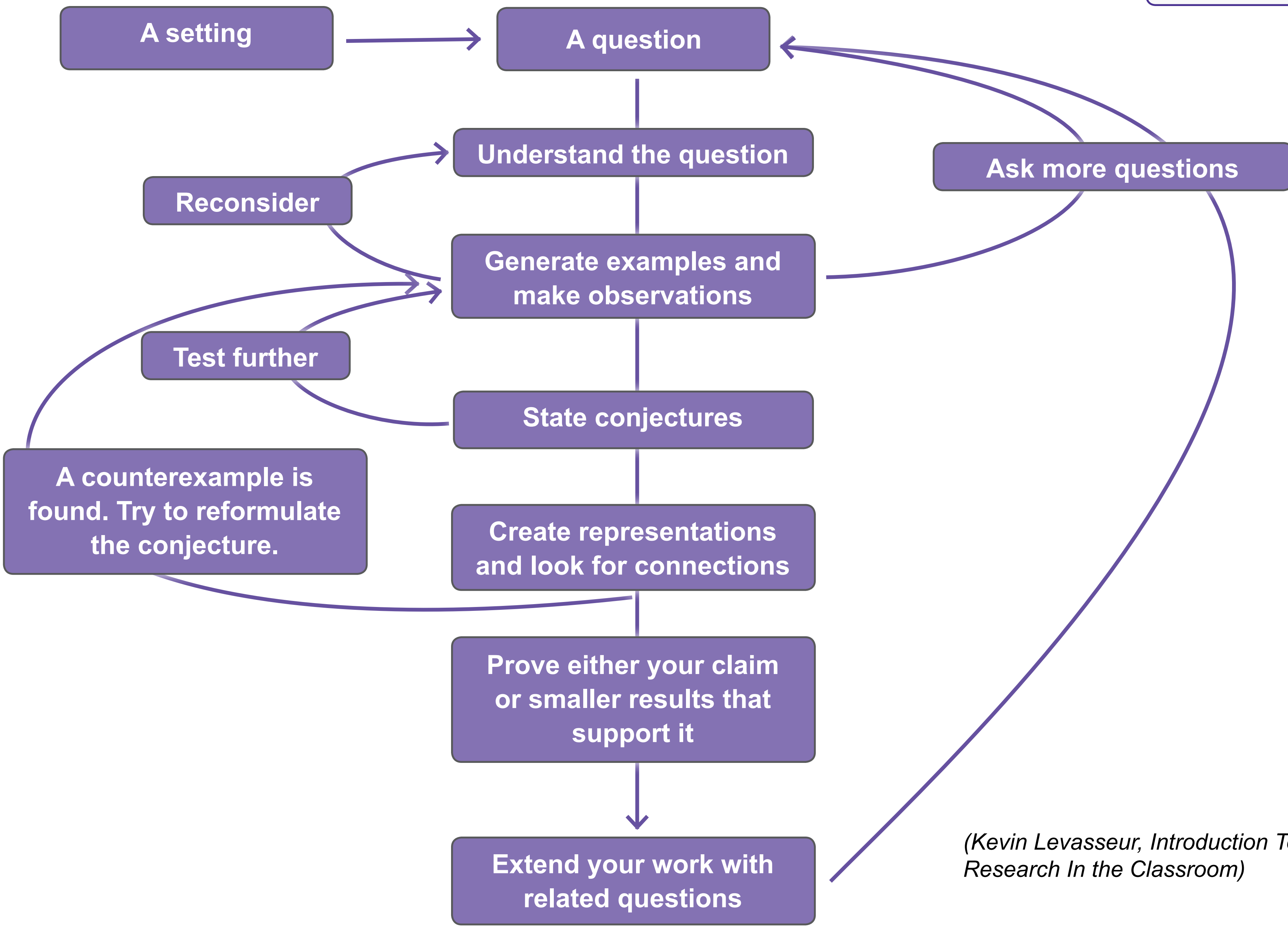


*(Kevin Levasseur, Introduction To Research In the Classroom)*

# Cross-Disciplinary Standards

Return

| I. Key Cognitive Skills |
| --- |
| A. Intellectual curiosity, Performance examples |
| **1. Engage in scholarly inquiry and dialogue.**<br>a. Identify what is known, not known, and what one wants to know in a problem.<br>b. Conduct investigations and observations.<br>c. Cite examples or illustrations in which a clear-cut answer cannot be reached.<br>**2. Accept constructive criticism and revise personal views when valid evidence warrants.**<br>a. Articulate a point of view and provide valid evidence to support findings.<br>b. Demonstrate willingness to take intellectual risks by investigating novel, controversial, or unpopular opinions or conclusions.<br>c. Examine alternative points of view, taking different roles to defend, oppose, and remain neutral on issues.<br>d. Recognize conflicting information or unexplained phenomena.<br>*(EPIC, 2008, p 59)* |

| I. Key Cognitive Skills |
| --- |
| E. Work habits, Performance examples |
| **1. Work independantly.**<br>a. Plan a project, establish its parameters, and complete it with minimal supervision, seeking assistance accordingly.<br>b. Follow directions or procedures independently.<br>c. Complete assignments outside the classroom setting in a timely manner.<br>**2. Work collaboratively.**<br>a. Work collaboratively with students from various cultural and ethnic backgrounds.<br>b. Distinguish between situations where collaborative work is appropriate and where it is not.<br>c. Work in small groups to investigate a problem or conduct an experiment.<br>*(EPIC, 2008, p a60)* |

# Cross-Disciplinary Standards

Return

| I. Key Cognitive Skills |
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a. Use different kinds of data (e.g., case studies, statistics, surveys, documents) to support an argument.
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*(EPIC, 2008, p 59)*

# Cross-Disciplinary Standards

Return

| I. Key Cognitive Skills |
|---|
| C. Problem solving, Performance examples |
| **1. Analyze a situation to identify a problem to be solved.**<br>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.<br>b. Break complex problems into component parts that can be analyzed and solved separately.<br>c. Apply previously learned knowledge to new situations.<br>d. Analyze a media report, identify any misuse of statistics, and suggest ways to more accurately depict this information.<br>**2. Develop and apply multiple strategies to solve a problem.**<br>a. Use a range of standard methods, devices, techniques, and strategies to gather and analyze information.<br>b. Use knowledge gained from other subject areas to solve a given problem.<br>**3. Collect evidence and data systematically and directly relate to solving a problem.**<br>a. Use general and specialized reference works and databases to locate sources.<br>b. Collect evidence and data directly related to solving the problem and eliminate irrelevant information.<br>c. Produce charts, graphs, and diagrams accurately, including scale, labeling, units, and organization.<br>d. Present the collected data visually, describe the data collection procedure, and defend choosing that procedure over other possibilities<br>*(EPIC, 2008, p 59)* |

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# Cross-Disciplinary Standards

Return

**II. Foundational Skills**

B. Writing across the curriculum, Performance examples

**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

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| II. Foundational Skills |
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| B. Writing across the curriculum, Performance examples |

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*(EPIC, 2008, p a60)*

# Cross-Disciplinary Standards

| II. Foundational Skills |
|---|
| C. Research across the curriculum, Performance examples |
| **1. Understand which topics or questions are to be investigated.**<br>a. Formulate research questions.<br>b. Use strategies like those in the writing process to generate questions and areas to pursue.<br>c. Consult previous studies or conduct interviews with experts to identify questions central to a research topic.<br>d. Propose explicit, testable hypotheses, using the "if ..., then ..." format.<br>**2. Explore a research topic.**<br>a. Produce an annotated list of sources consulted, differentiating among primary, secondary, and other sources and explain their relevance to the research topic.<br>b. Outline the most significant controversies or questions on a research topic.<br>c. Plan an investigative study.<br>d. Explain reasons for valid competing points of view on a given topic.<br>**3. Refine research topic based on preliminary research.**<br>a. Gather information from a variety of relevant sources.<br>b. Use general and specialized reference works and databases to locate sources.<br>c. Locate electronic sources, when appropriate, using advanced search strategies.<br>d. Select an appropriate range of source materials.<br>e. Analyze a wide range of sources, including technical texts, primary and secondary sources, conflicting points of view, and interdisciplinary research when appropriate.<br>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.<br>g. Use numerical and mathematical tools such as software, including databases, spreadsheets, and other tools, in investigations and explanations. |

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# Cross-Disciplinary Standards

Return

| II. Foundational Skills |
|---|
| C. Research across the curriculum, Performance examples |

**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

| II. Foundational Skills |
|---|
| C. Research across the curriculum, Performance examples |

**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.

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# Cross-Disciplinary Standards

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| II. Foundational Skills |
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| C. Research across the curriculum, Performance examples |

**4. Evaluate the validity and reliability of sources.**

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b. Follow a set of criteria to determine the validity and reliability of sources.
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*(EPIC, 2008, p a63)*

# Cross-Disciplinary Standards

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| II. Foundational Skills |
|---|
| D. Use of Data |
| **1. Identify patterns or departures from patterns among data.**<br>a. Identify patterns from multiple representations of data such as graphical and tabular forms.<br>b. Review current news events and evaluate possible connections (e.g., linking economic data with political events).<br>**2. Use statistical and probabilistic skills necessary for planning an investigation and collecting, analyzing, and interpreting data.**<br>a. Create representations of data (e.g., data tables, correctly labeled and scaled graphs, narrative descriptions).<br>b. Evaluate a given published report for missing information and misuse of data.<br>**3. Present analyzed data and communicate findings in a variety of formats.**<br>a. Compose a written document detailing a research project.<br>b. Use appropriate visuals and statistical results to convey findings to a specified audience.<br>*(EPIC, 2008 p. a64)* |

# Cross-Disciplinary Standards

Return

| II. Foundational Skills |
| --- |
| C. Research across the curriculum, Performance examples |

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d. Propose explicit, testable hypotheses, using the "if ..., then ..." format.

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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.

*(EPIC, 2008, p a63)*

# Cross-Disciplinary Standards

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| 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)*

# Cross-Disciplinary Standards

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| II. Foundational Skills |
|---|
| E. Technology |
| **1. Use technology to gather information.**<br>a. Use the Internet or other appropriate technologies to post survey questions on an assigned topic.<br>b. Use devices to measure physical properties.<br>c. Use online databases to access scholarly work on an assigned research topic.<br>**2. Use technology to organize, manage, and analyze information.**<br>a. Use data analysis software to analyze survey results.<br>b. Use spreadsheets to manage and organize statistical data.<br>**3. Use technology to communicate and display findings in a clear and coherent manner.**<br>a. Create spreadsheets and graphs to communicate findings in a presentation that includes graphics, visuals, or other supporting images.<br>b. Utilize technology to present information and/or data in a variety of ways.<br>**4. Use technology appropriately.**<br>a. Explain how technology is a useful and effective tool to communicate findings.<br>b. Identify when technology may not be necessary or appropriate to communicate findings.<br>c. Formulate strategies to communicate findings with and without technology.<br>*(EPIC, 2008 p. a65)* |