

<h1 style="text-align: center;">Science</h1>	<p>The content for this component was provided by Public Consulting Group’s Center for Resource Management, in partnership with the Council of Chief State School Officers. Feedback was provided from partners and state education officials who participated in the secondary school redesign project.</p> <p>Mission Literacy</p> <p>http://www.missionliteracy.com/uploads/3/1/5/8/3158234/ccsso_contentarealiteracyguide.pdf</p>
<p>Graphic Organizers During and after reading of a chemistry text chapter on acids, bases, and salts Model or have students create a graphic organizer, such as a process cycle, cause/effect diagram, or a Frayer Model as a study guide that organizes information about these compounds as a study guide.</p>	<p>Anticipation Reaction Guide Before, during, and after reading a global warming report issued by international scientists: Have students anticipate and react to the text, using the response headings of Supported by Evidence/Not Supported by Evidence, including statements such as:</p> <ul style="list-style-type: none"> • Increasingly hotter temperatures around the globe show global warming is occurring. • Hurricanes will continue to increase in frequency, especially in southern locations. • Human causes are the leading reason for global warming.
<p>Bloom’s Critical Thinking Cues During reading a text chapter, reviewing graphic depictions, and viewing a video on plate tectonics</p> <p>Structure a two-column note taking chart with prompts derived from Bloom’s cue questions chart that require students to analyze, evaluate, and synthesize the information on plate tectonics and correlate it to geological features in today’s world.</p>	<p>Coding/Comprehension Monitoring During reading of a local newspaper in an integrated science course Have students color code (with highlighters or sticky notes) information in the newspaper to identify science-related topics, such as: yellow = earth science pink = life science orange = physical science</p>

<p>Discussion Web Before, during, and after reading online resources about space science Provide a controversial prompt to stimulate students thinking, such as “The United States should cancel its space program.” Have students take pro and con notes on the Discussion Web template as they read various online resources in preparation for writing an editorial expressing their viewpoints that will be sent to NASA or the U.S. Congress.</p>	<p>Fishbowl Discussion After reading about a controversial issue such as stem cell research</p> <p>Set up a scenario like a TV show where the host or hostess tends to “attack” the visiting guests. Divide the class into those who support or disagree with the use of stem cells for research, based on available information from newspaper articles, medical journals, or other sources of research. Have students who are supporting stem cell research develop a list of reasons why the experimental research should continue. Students opposed to the research will develop reasons as to why the research should not be allowed.</p> <p>Let the groups plan their dialogue for the interview. Then have one member from each group enter the fishbowl to begin the interview and periodically change the group until all students have been involved.</p>
<p>Frayer Model Before and after viewing a video about the properties and changes of properties in matter</p> <p>Before the video, use the Frayer Model strategy for one of the film’s concepts, telling students they will be creating a Frayer Model for a term or concept they do not fully understand during the video. After the video, have students work in pairs to create a Frayer Model for the term or concept each student found difficult. Have each pair exchange their Frayer Models with another pair and offer feedback and additional ideas.</p>	<p>Group Summarizing Before, during, and after reading, watching demonstrations, and solving related problems about electrostatics</p> <p>Use group summarizing for an individual and small group review of primary concepts for the unit test, such as:</p> <ul style="list-style-type: none"> • Conservation of charge • Coulomb’s law • Charging by friction and contact • Charging by induction

<p>Interactive Word Wall</p> <p>Before, during, and after reading articles in a computer technology course about the new “thinking” technology called the Semantic Web</p> <p>As the class reads articles about the Semantic Web, have students create a Word Wall with important terms, such as search engine, algorithms, relational database, RDF, GPS, logic engine, DNA computer, cubits, and quantum computing.</p> <p>Have students interact with these words, such as:</p> <ul style="list-style-type: none"> • Creating Triple-Entry Vocabulary Journal entries about each word on the wall that include a definition in their own words and a visual memory aid. • Writing a short Quick Write defining the Semantic Web, using at least nine terms from the Word Wall. • Drawing a Venn diagram that compares the World Wide Web and Semantic Web using Word Wall terms. 	<p>Jigsaw</p> <p>Before, during, and after reading text and online materials about the cardiovascular system</p> <p>Form study groups to collaboratively read and research one of the three areas below, then form jigsaw groups after reading is completed for peers to share materials and teach each other the essential components and related vocabulary for each system:</p> <ul style="list-style-type: none"> • Blood composition • The heart • Vessels and blood circulation
<p>Knowledge Rating Guide</p> <p>Before, during, and after reading text, online, and media resources about atomic structure</p> <p>Use the KRG to stimulate interest and activate knowledge about atomic structure by using a mix of statements related to atomic theory and authentic real-life applications, such as:</p> <ul style="list-style-type: none"> • Artificial ingredients in foods • Dalton’s atomic theory of matter • Static electricity in the home (dryer, rug, pet) • Cathode rays • Electrons • Nuclear power plants • Nuclear atom • Atomic numbers 	<p>Problematic Situation</p> <p>Before, during, and after reading text and online resources about alternative energy</p> <p>Set up a problematic situation to stimulate student inquiry about the impact of alternative energy.</p> <p>Example:</p> <p>Northeast Energy recognizes the limited supply of fossil fuels and they have been encouraging their clients to conserve energy. While conservation is important, at some point in the not-so-distant future, they realize that our supplies of fossil fuels will be depleted and we will be forced to rely only on alternative energy sources.</p> <p>You have been contracted to evaluate the feasibility of using perpetual and renewable energy sources to provide power for their client, particularly solar, hydroelectric, wind, geothermal, biomass, and nuclear power. They are also interested in any other alternatives. What information can you provide that will help them in their future planning?</p>

<p>Paired Reading During the text review and before the lab experiment for Newton’s Second Law of Motion—force and acceleration</p> <p>Have students do a Paired Read to summarize the text explanations of Newton’s Second Law with the key outcome of understanding:</p> <ul style="list-style-type: none"> • The proportional relationship between acceleration and net force • The inversely proportional relationship of acceleration and mass • Reactions that will occur when acceleration, net force, or the mass changes 																
<p>Question Answer Relationship (QAR) After reading a variety of articles on global warming Model the QAR question development with one article and then have small groups of students practice creating their own QAR questions to analyze the facts and opinions in the articles, using the following cue words to identify the type of question:</p> <ul style="list-style-type: none"> • Right there: who, where, list, when, how many, name, what, based on this passage • Think and search: summarize, what caused, contrast, explain, retell, how did, find • Author and me: in what instances • On my own: what do you think, based on your experience, if you were this person 	<p>Quick Write Before, during, and after reading any text information Have students do a Quick Write based on a prompt that asks them to summarize, analyze, or evaluate scientific concepts, such as:</p> <ul style="list-style-type: none"> • Light travels through the air at 3×10^8 m/s. This is also the speed limit of the universe. Explain the meaning of 3×10^8 m/s. What does it mean to say that the universe has a speed limit? • Brainstorm a list of everything you know about the causes and effects of global warming on the environment. 															
<p>Reciprocal Teaching During reading of a difficult chemistry chapter on chemical equilibrium and Le Chatelier’s Principle</p> <p>Have students take on the four roles of Summarizer, Questioner, Clarifier, and Predictor after reading each of the sections. Tell each role to focus on specific content when reading:</p> <p>The <i>Summarizer</i>: Focus on the opening and closing paragraphs of each 1–2-page section The <i>Questioner</i>: Read the Section Review Questions and ask the group any you don’t understand yourself. The <i>Clarifier</i>: Review the graphs and figures that explain the reactions. The <i>Predictor</i>: Read the sample problems and Chemistry in Action tips to predict why it matters for students to understand chemical equilibrium.</p>	<p>Word Sort Before reading chapters about chemistry, botany, and genetics in an Integrated Science course</p> <p>Use the Word Sort to assess student understanding of the various science fields</p> <p>Categories: Chemistry, botany, genetics</p> <p>Words to sort:</p> <table border="0"> <tr> <td>abnormal</td> <td>flagellum</td> <td>polarity</td> </tr> <tr> <td>adaptation</td> <td>gene</td> <td>sac</td> </tr> <tr> <td>agglutination</td> <td>infusion</td> <td>solvent</td> </tr> <tr> <td>annual</td> <td>nutrient</td> <td>synthetic</td> </tr> <tr> <td>cyclical</td> <td>photosynthesis</td> <td>transpiration</td> </tr> </table>	abnormal	flagellum	polarity	adaptation	gene	sac	agglutination	infusion	solvent	annual	nutrient	synthetic	cyclical	photosynthesis	transpiration
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Word Study

During and after reading scientific text

Create a word wall for key roots related to the science course, adding words throughout the year that include the root.

Examples:

Centr (Greek) = center

centrifugal, centripetal, concentric, centralize

Derm (Greek) = skin

dermatitis, hypodermic, taxidermy, endoderm, dermis, pachyderm, ectoderm

Bio (Greek) = life

Biology, antibiotic, biosphere, biodegradable, biopsy, biochemical, bioluminescence, biometrics, amphibious

ReQuest

During reading and learning about the structure and mechanics of change in DNA

During the DNA unit, begin each class with a 10 minute ReQuest about the previous day's learning and the homework reading. Encourage students to identify questions about the processes in both healthy and unhealthy persons.

Examples:

- Cellular reproduction beginning with the double helix theory of DNA structure and function
- Relationships between the anatomical and biochemical processes in determining heritable characteristics
- How genetic engineering can result in new combinations of genes and new inherited characteristics
- The beneficial and harmful nature of organisms
- The evolutionary processes in terms of diversity that are factually observable

RAFT

Before, during, and after reading various text, graphic, and visual materials about patterns of change in volcano and earthquake activity

Have students summarize their understanding of the patterns of change through creative RAFT writing or presentations, such as:

Role	Audience	Format	Topic
Research lab scientist	City planning board	Presentation on needed regulations	Probability of earthquake within 20 years
Doomsday religious fanatic	Protest at governor's office	Pamphlets and home-videos	Recent volcano eruption in state is proof the end is near
Neighbors	Environmental Protection Agency	Petition for insurance coverage	Need for EPA to require insurance for earthquake damage

Save the Last Word for Me

Before, during, and after reading newspapers for current science issues

Have students copy a scientific newspaper reference that they find interesting, such as:

"Fluorescent filaments of the organisms, known as cyanobacteria, began forming in the river last week and by yesterday they streaked the Esplanade lagoons a psychedelic green."—I'm intrigued because a tiny bacteria caused a major transformation in a short period of time and I wonder how they will get the algae under control.

"Carnoustie, Scotland—Rain was pelting. Sideways, as they say over here. It was a cold rain, too. And the wind? Surely, even the foundation of Glamis Castle had to be shaking."—I picked this as the only part of the paper I really like reading is the Sports section and I enjoy learning how weather affects sports, in this case golf.

Semantic Feature Analysis

Before, during, and after reading about systems of the body

Help students determine the interrelationships (or not) of human systems that impact health.

Systems codes:

S = Skeletal M = Muscular E = Endocrine

C = Cardiovascular D = Digestive U = Urinary

L = Lymphatic R = Respiratory N= Nervous

Fitness	S	M	E	C	D	U	L	R	N
Heart									
Cancer									
Diabetes									
Obesity									
Liver									
Alzheimer's									

Triple-Entry Vocabulary Journal

During reading of chapter on the blood composition of the cardiovascular system

Help students compare types of blood composition

Blood composition type	Your Definition	Your Memory Picture/Phrase
Basophils		
Eosinophils		
Lymphocytes		
Monocytes		
Neutrophils		

Think-Aloud

During reading of a passage on ionic bonding
Help students use figures and graphs to understand text passages with a think-aloud:

Who can draw an ionic compound? When no hands went up, the teacher realized students overlooked the figures in the text during the homework reading. "I'll do a Think-Aloud to show you how to figure it out. So I'm you last night, reading along on the page about how combining sodium ions and chloride ions creates sodium chloride. So I try to picture that in my mind and what I see is like stirring eggs in a cake mix where the ingredients dissolve together. But is that the right image? I see that the text says see Figure 7-2. I quit reading the words and spend a few minutes analyzing the graphic of a cube-like structure with green and gray dots. What's the point, I think? Then I read the sidebar explaining the figure, and I see it asks: How many sodium ions surround each chloride ion? Hmm, I didn't even look for a pattern like that. That's cool—no matter which chloride ion I look at all over the 3D cube, there are always 3 sodium ions around it. And vice versa when chloride ions surround the sodium ions. So that's what they mean by balancing the electrical charges."

Two-Column Note Taking

After reading each chapter and completing the related lab or applied task

Have students keep a weekly journal to record their understanding of how science changes cause varied effects and reactions.

Weekly topic: _____

Example: Magnetism

Cause	Effect
Motion of electric charge	Produces a magnetic field
Interactions among adjacent iron atoms	Large clusters of the atoms line up with each other
A magnet is broken into two pieces	Each piece retains equally strong poles
Placing pieces of iron in strong magnetic fields or stroking a piece of iron with a magnet	A permanent magnet is made