presenting an event or phenomenon that they find interesting or intriguing. The story presents the content in a context that serves as a framework around which students build conceptual understandings. Throughout a chapter, students may return to the story to determine how a concept might apply. The story also presents a challenge or question that students must address by applying the conceptual understandings that they have acquired during the chapter.

- **TECHNICAL SUPPORTS INCLUDING THE READ SPEAKER (READ ALOUD) FUNCTIONALITY**

Read Speaker can read any text in the student book when viewed online, including readings, lab procedures, picture captions and more.

- **ENGAGING VISUALS FOCUS STUDENT ATTENTION AND SUPPORT LANGUAGE ACQUISITION**

EDC Earth Science has more than 300 color photos, tables, graphs, and illustrations, each with expanded captions that provide detail on the graphic content. Color slide deck presentations are provided for each chapter to help focus student attention to the content at hand.

- **USE OF CARD SORT TECHNIQUES FOR DIFFERENTIATING TEXT-BASED ACTIVITIES HELPS**

For example, "Calling All Carbons," (Chapter 5, Activity 4) can be done from the SE alone, or by using the "Carbon Cards" that are based on the same pictures and text that appear in the SE on pp. 128-131. For many EL students, the ability to examine and sort these cards individually, provides a valuable scaffold to help learn the content.

- **DEDICATED LITERACY SUPPORTS**

These are provided as embedded support for every student reading, using Science Fact Triangle, Anticipation Guides, and Three-Level Reading Guides that appear ready-to-use as Literacy Supports, referenced the "Materials Needed" in both the SE and TE. Support for *Write As You Read, Talking Drawing, Cornell Notes, Writing Frames, Concept Maps,* and *Science Notebooks* is also included. Lexile levels for the book range from 1,060 to 1,210, which corresponds to grade 10. Supports for oral presentations, think-pair-share, and other oral strategies are included.

- **VOCABULARY SUPPORT IS PROVIDED THROUGHOUT**

When new scientific terms are used in the readings for the first time, they are always highlighted and defined. A comprehensive glossary is appended in the SE.

- **ASSESSMENT STRATEGIES INCLUDE MANY OPPORTUNITIES FOR FORMATIVE ASSESSMENT**

Each chapter includes a table that maps opportunities to use formative and assessment strategies to the learning goals for each chapter.

EDC Earth Science features well-structured teacher support for EL instruction. The Overview section found in the front of the Teacher's Edition describes each of the focus areas above, and additional information is provided in each chapter overview.

TEACHING LITERACY SKILLS WITH *EDC EARTH SCIENCE*

Literacy skills are at the heart of thinking and learning. For students to organize and internalize concepts and information, and thereby construct understanding, they must be able to comprehend and critically analyze the information that they read, view, and hear. They must be able to communicate their ideas in ways that demonstrate sound reasoning based on evidence. As well as reading and writing, literacy skills include speaking, listening, and analyzing information and conveying it in a variety of forms and media.

The *Common Core State Standards* for English Language Arts and Literacy in History/Social Studies and Technical Subjects sets high standards for student literacy. The introduction to the standards says:

> "Students who meet the Standards readily undertake the close, attentive reading that is at the heart of understanding and enjoying complex works of literature. They habitually perform the critical reading necessary to pick carefully through the staggering amount of information available today in print and digitally. They actively seek the wide, deep, and thoughtful engagement with high-quality literary and informational texts that builds knowledge, enlarges experience, and broadens worldviews. They reflexively demonstrate the cogent reasoning and use of evidence that is essential to both private deliberation and responsible citizenship in a democratic republic" (Council of Chief State School Officers & NGA, 2010, p. 3).

The *Framework* makes it clear that teaching literacy skills should be an integral part of teaching science. The *Framework* states literacy skills are critical to building knowledge in science...[and] reading in science requires an appreciation of the norms and conventions of the discipline of science, including understanding the nature of evidence used, an attention to precision and detail, and the capacity to make and assess intricate arguments, synthesize complex information, and follow detailed procedures and accounts of

events and concepts....Likewise, writing and presenting information orally are key means for students to assert and defend claims in science, demonstrate what they know about a concept, and convey what they have experienced, imagined, thought, and learned.. (NGSS, Appendix M, p.1). The *NGSS* advise that students should be actively engaged in making and documenting observations; reading a range of scientific text materials; and incorporating a mix of words, diagrams, charts, symbols, and mathematics.

The teaching of literacy skills does not compete with, but rather supports, the teaching of science concepts and practices. Thier and Daviss, quoted in Worth, Winokur, Crissman, & Heller-Winokur (2009), say that "science and language are inextricably linked in the pursuit, determination, and communication of meaning through discussion, reading, writing, and other forms of representation."

EDC Earth Science provides a rich set of opportunities for students to develop and apply their literacy skills. Students

- *gather information* by engaging with readings in a variety of forms; analyzing data and information displayed in maps, graphs, charts, and photographs; researching topics on the Internet; and carefully observing phenomena.
- *build conceptual understanding* by organizing observations in tables and other data displays, documenting their thinking in writing, and discussing ideas with their peers.
- *communicate learning* through written projects (five-paragraph essays, business plans, and brochures) and orally (formal slide presentations, scientific poster sessions, and structured debates). Students are encouraged to incorporate a variety of new media as they gather, analyze, and communicate scientific information to meet the challenges within each chapter.

• USE OF STORY IN *EDC EARTH SCIENCE*

Stories have long been a means of conveying information, describing events, and passing on cultural history and skills. Story can also be used to engage and motivate learners. A good story will inspire readers to want to learn more about the subject or challenge them to acquire the knowledge required to solve a problem or conundrum presented in the narrative. Science stories in *EDC Earth Science* serve several purposes. Initially, the story engages students' interests by presenting an event or phenomenon that they find interesting or intriguing. The story presents the content in a context that serves as a framework around which students build conceptual understandings. Throughout a chapter, students may return to the story to determine how a concept might apply. The story also presents a challenge or question that students must address by applying the conceptual understandings that they have acquired during the chapter. Stories in *EDC Earth Science* relate historical events, recent newsworthy events, and in some cases fictionalized scenarios.

• LITERACY SUPPLEMENTS

The literacy supplements in *EDC Earth Science* help respond to the goals of the ELA 9–12 Reading and Writing Standards for Science and Technical Subjects in the *Common Core State Standards* (Council of Chief State School Officers & NGA, 2010), and their use is based on three beliefs (Wellington & Osborne, 2001):

- Learning the language of science is a major part of science education; every science lesson is a language lesson.
- Language is a major barrier to learning science.
- There are practical strategies that can help overcome these barriers.

To that end, *EDC Earth Science* provides concrete, embedded strategies to support students in reading, writing, oral discussion, and presentations. These have been adapted from programs used by teachers and researchers across the country. The following pages provide a brief description of the strategies and a table to show their distribution throughout the course.

Literacy supplements often take the form of single sheets that can be duplicated for classroom use. These can be found in the Teacher Resources.

• READING

The Lexile readability scores for the 17 chapters in *EDC Earth Science* range from 1,060 to 1,210. This corresponds to grade 10 or the level suitable for most high school sophomores (and grades 11–12), but the course can be taught to younger students if the Literacy Supplements described in this section are used. The *Framework* recognizes that reading in science is challenging for three primary reasons: (1) scientific terms are often unfamiliar to students; (2) the mode of reading is different from what students have experienced in language arts classes, because the meaning of words and phrases must be precise; and, (3) in addition to words, science texts incorporate diagrams, charts, graphs, maps, symbols, photographs, and mathematics as key elements for communicating ideas (NRC, 2012). *EDC Earth Science* provides many opportunities for students to improve their abilities to comprehend and apply the information in scientific texts.

Each chapter has one or more readings that serve many functions: they may be stories that serve to engage students by relating what they are about to learn to real-world situations (such as in What's the Story?); they may provide background information needed to complete an activity; or they may summarize the conceptual understandings that students should have acquired during the learning experience.

When new scientific terms are introduced in the readings they are highlighted and defined. Although a glossary is provided in the back of the book, students are encouraged to build their own glossaries of terms in their own words as they move through the course to help them reflect on the meaning of the terms. Students should be encouraged to incorporate the scientific terminology into their writing assignments and class discussions. In this way, they build not just the scientific ideas, but also the terms associated with them, into their conceptual understanding.

The readings also contain many maps, graphs, photographs, and diagrams that convey critical content. Students may have limited experience reading and interpreting some of the data visualizations that are common in earth science—particularly maps and other illustrations that require spatial visualization (Ishikawa & Kastens, 2005; Krumhansl, et al., 2012). Although research indicates that spatial thinking is a skill that can be learned, it is not systematically taught in the K–12 curriculum (NRC, 2006). When discussing readings in class, you may project slides of the figures related to the readings. These are provided in the Teacher Resources. You will want to make sure students are noticing the elements of these illustrations and extracting the intended meanings.

Each reading contains information that students must use to address the chapter challenge. The purpose of the reading is communicated to the students before they read, and the About the Reading questions focus them on the information they should retain and require them to think about how this information relates to the challenge.

You might apply a number of strategies with students to complete the reading tasks. Some of the readings may be read out loud during class time; some may be completed as homework; and some may be achieved through organizing students into jigsaw reading-and-sharing groups. In every case, it is critical to discuss the reading and About the Reading questions as a class. This gives you an opportunity for a formative assessment of students' understandings of the information in the reading and a time to reinforce key ideas. The following types of Literacy Supplements are provided in the teacher edition, with the application of a support customized for each reading in the course:

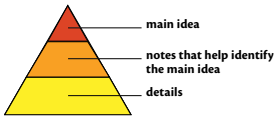
• LITERACY SUPPLEMENTS IN *EDC EARTH SCIENCE*

Anticipation Guide

Anticipation Guides (Herber, 1978; Wood, 2001) help stimulate discussion and students' critical thinking to enable them to better understand expository and narrative material. The guides consist of a series of statements that help elicit students' knowledge about key concepts before reading a selection, and a postreading review of those statements for students and the teacher to see how their knowledge has changed.

Science Fact Triangle

This strategy calls for students to record important concepts and facts from a reading, and to organize the information to highlight the main idea of the reading. The Science Fact Triangle (SFT) is adapted from Buehl's Fact Pyramid literacy technique (Thier & Daviss, 2002, pp. 102–103). It is a simple triangular graphic that helps students who are unable to "see the forest for the trees." You may have students approach this in either of two ways. One is to have students start at the top where they identify the main idea (expressed as a sentence), and then move down the levels by filling in notes needed for the short term to identify the main idea, and leaving the base of the pyramid for details. Or, have students start at the bottom, noting details, notes, and main idea in reverse.



Three-Level Reading Guide

A Three-Level Reading Guide (Vacca & Vacca, 1995) is a sheet of statements students use to analyze a selection from a reading. It allows students to record their reading comprehension at three levels:

Literal—Understanding the literal meaning of the words and ideas in a reading selection.

Interpretive—Grasping the "message" of the selection or understanding what the author meant by the passage.

Applied—Relating the selection's message to other experiences or contexts.

Unlike many other postreading strategies that require extensive writing, this strategy focuses on students processing the ideas they have read.

• ADDITIONAL READING STRATEGIES

Write As You Read

This strategy enables students to become more active readers as they identify and jot down key concepts, words, and passages as they come across them in the text. It helps them further develop the internal monologue that characterizes proficient readers (Thier & Daviss, 2002). Have students use science notebooks or journals or sticky notes that can be later collated in their notebooks and can serve as study guides for later. Possible prompts for making a note include:

- What is the main idea or topic?
- Make a mark next to parts you don't understand.
- Highlight parts you find especially interesting (not the whole text!).
- Circle parts you agree with.
- Identify words you don't know.
- Underline or mark parts your teacher wants you to know.
- Write a short summary (2 or 3 sentences) of the reading.

For time management's sake, it is important for you to identify no more than two of these bullets for students to use for a reading. These can be varied from reading to reading for the sake of variety or for particular problems suggested by the reading.

Talking Drawing

A talking drawing (Wood, 2001) involves students either making or interacting with a drawing suggested by the reading on a pre- and post-reading basis. It helps students connect what they know about a topic with what they are about to learn. The talking drawing is a proven way to help enhance students' understanding and recall.

• BUILDING COMMUNICATION SKILLS

EDC Earth Science helps students develop their communication skills by providing opportunities to demonstrate their knowledge by written, oral, and visual means. Students gain confidence by giving oral presentations, ranging from informal sharing of ideas and models to full-blown prepared presentations with visuals. Often in the course, students are given a choice of ways to demonstrate their learning, although all students are required at some point to employ diverse communication strategies, such as videos, brochures, written essays, position papers, newspaper articles, poster sessions, museum exhibits, construction of 3-D models, debates, and letters. Students can take notes and record observations and ideas in their notebooks and data tables. As students attempt to communicate in order to teach others, they develop such skills as logical organization of ideas, clarity in expressing ideas, and identification of major points to be made in a limited amount of time.

The following strategies support and encourage students' writing and note-taking skills:

Cornell Notes

The Cornell note-taking system was devised in the 1950s by Walter Pauk, an education professor at Cornell University. The Cornell method provides a systematic format for condensing and organizing notes. First, students divide a sheet of paper into two columns: the note-taking column (usually on the right) should be twice the size of the questions/key-word column (on the left). They should leave about two inches at the bottom of the page.

Students write notes from a lecture or teaching in the note-taking column. Such notes usually consist of the main ideas of the text or lecture; long ideas are paraphrased. Students should avoid long sentences, and use symbols or abbreviations instead. To assist with future reviews, students write relevant questions or key words in the key-word column.

Within 24 hours of taking the notes, students revise their notes, write new questions, and then write brief, five to seven line summaries in the space at the bottom of the page. This helps to increase their understanding of the topic. When studying for either a test or quiz, students will have a concise but detailed and relevant record of previous classes.

Science Notebooks

Students should keep science notebooks throughout the *EDC Earth Science* course. Just as a scientist would, students use their notebooks as an informal place to record data, process their ideas and thinking, and build observation skills. The emphasis should be placed on keeping the notebook as an informal place for building knowledge, and while students may use a variety of formats, sometimes they need to record data in a hurry. Notebooks should not take on the appearance of a formal work product—just as a scientist will work up data and observations to produce a paper for publication, students may produce a more formal work product using information logged in their science notebooks when needed.

You may require your students' notebooks to follow one or more of the following guidelines:

- Write daily entries with a clear heading and date.
- Leave space at the beginning for a table of contents and at the end for appendices.

- Use a uniform style for major entries. Elements could include the use of pen or pencil; rules for margin notes, data, or drawings; or standards for attaching and displaying teacher handouts.

You may elect to inspect notebooks regularly and ask that they be left in class instead of taken home each day. There are many online sources for using science notebooks, as well as a good discussion in the book *The New Science Literacy,* by Thier & Daviss (2002).

Writing Frames

A writing frame is a task-specific outline for students. They fill in the frames to come up with technically sound, if somewhat formulaic, paragraphs to give them writing confidence. Over time, you may remove some prompts, based on the difficulty of the assignment.

Concept Maps

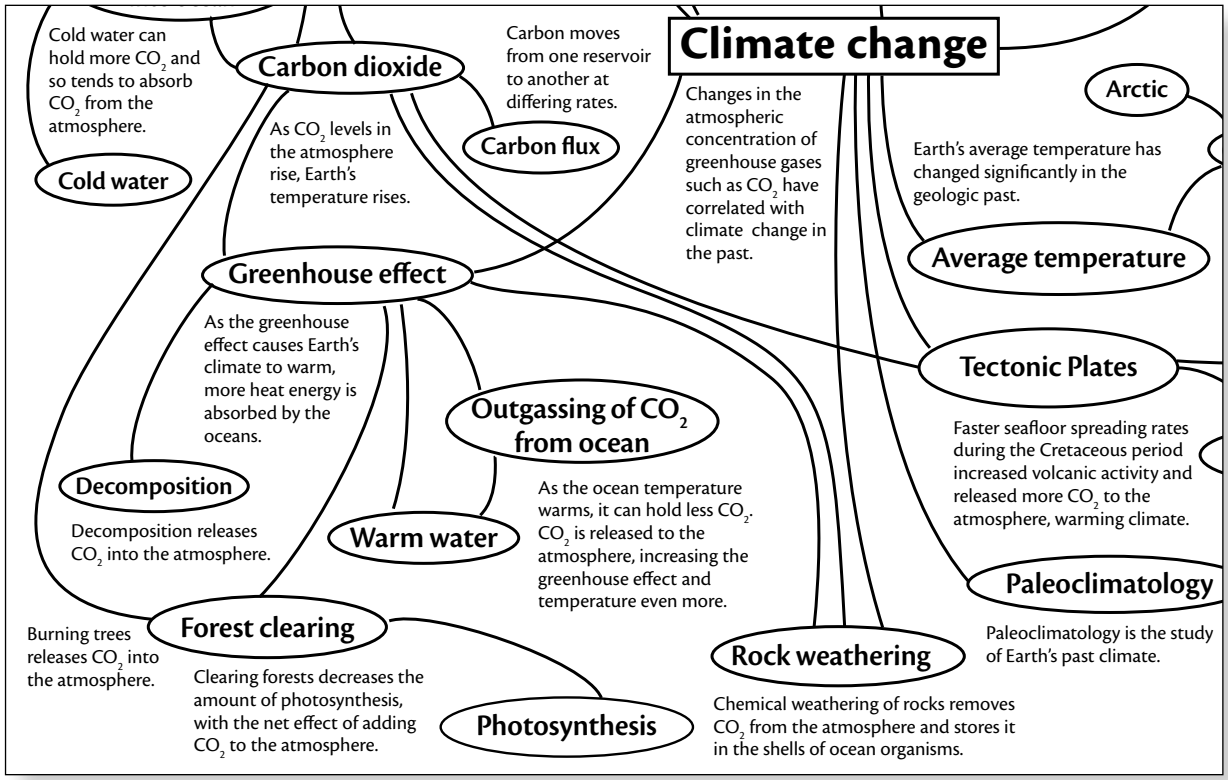
Concept maps are diagrams that illustrate the connections between certain concepts. They provide a way for students to organize information, identify relationships among concepts, and identify gaps in their own understandings. Students' concept maps enable you to identify any misconceptions, assess their understanding, and introduce and review concepts visually.

A concept map usually focuses on a main idea, supported by related ideas and describing connections between ideas. Concepts are placed in circles and linked by lines to other concepts. Words on the connecting lines indicate the relationship between ideas. Concepts should generally be linked to two or more ideas and have branches and cross-linkages.

Emphasize to students that no single concept map is correct. But while there may be no "right" map, maps can be incomplete or have incorrect connections. Ideas of connections can change as students' better understand these concepts. Students may want to initially construct concept maps with sticky notes that enable them to change connections as their understanding increases.

• DISCUSSION AND ORAL PRESENTATION

Class discussions are an integral strategy for teaching and learning in *EDC Earth Science.* Whole-class discussions not only give you a chance to probe students' understanding, they also give students the opportunity to relate their experiences to the topic of discussion. This makes the subject authentic, practical, and relevant. Students can use discussion to explain their ideas and provide evidence for their conclusions. The process of critiquing explanations in a public forum enables students to reach a greater depth of understanding and to confront certain preconceptions.



Partial concept map for climate change (see Resource supplement 6.1*)*

There are many questions posed in each chapter that help you focus class discussions. The Brainstorming questions at the beginning of each chapter will reveal existing knowledge and preconceptions. Questions provided with the activities and readings will help to reinforce key information, and often invite students to apply what they've learned to different contexts.

Discussions inform instruction by enabling you to assess knowledge and determine levels of understanding, logic, and reasoning.

Since students may not be accustomed to discussions in science classrooms, such sessions at the beginning of the year may seem labored. Encouraging all students to participate and to practice "wait time" will increase class participation and the quality of the responses. Allowing students to have small-group discussions before entering into whole-class discussions will give more reticent students a chance to gain confidence in speaking before a group and to learn the value of their contributions.

Your task as facilitator is to

- pose thought-provoking questions.
- break larger questions into smaller, more manageable ones.
- help students clarify their thinking by rephrasing or asking different questions.
- keep discussion focused on the concepts being explored.
- help students practice discussion etiquette in listening and responding to others.

Oral presentations are likely to be intimidating to students at first, although as they gain practice speaking before each other they will become more comfortable. Initially, you could provide opportunities for informal presentations of group work, with simple rules, such as "all group members should have a part in the presentation." Formal presentations should have clear guidelines and rubrics, and you should expect students to participate as active, respectful listeners when classmates are presenting.

The following strategies help encourage productive class discussions and oral presentations:

Take a Stand

This oral literacy strategy calls for students to physically orient themselves in the classroom depending on their position on an issue. Once there, students discuss reasons for their positions. With the teacher, they can compare and contrast the main points and differences between groups. This can be along a single continuum, for example, to show whether they "strongly agree," "agree," "disagree," or "strongly disagree" in response to a prompt or question. For example, in response to possible actions to save the most energy in a daily commute, those favoring carpooling, public transportation, telecommuting, etc., would occupy different parts of the room. An interesting variation is to have students in one area argue persuasively in order to get other students to change their minds; still another variation is for students to post their opinions on a sticky note and post on the whiteboard for all to see.

Think-Pair-Share

Have students first think or write responses to a prompt that you give them, and then have them discuss their responses with another student, generally a lab partner. You can then have them share their ideas orally with the entire class.

Chalk Talk

This is a "silent" class discussion strategy designed to encourage the participation of quieter students and help focus students' thinking and ideas around key concepts. Students sit on desks so that all can see and easily access the board. After you write a question or concept on the board (for example, "energy"), students then (without any talking) write ideas about that concept on the board, connecting their thoughts with a line to the original concept or to those written by other students.

Oral Presentation Guidelines

These can include informal, exploratory speaking and listening, or more-formal presentational speaking. Thier & Daviss (2002) have developed performance expectations for each type of speech that helps develop a rubric for evaluation purposes.

PERFORMANCE EXPECTATIONS FOR EXPLORATORY SPEAKING

- Initiates new topics and responds to others
- Asks relevant questions
- Responds to questions with appropriate explanation and details
- Uses language cues to indicate different levels of certainty
- Confirms understanding by paraphrasing what others have said

PERFORMANCE EXPECTATIONS FOR PRESENTATIONAL SPEAKING

- Speaks clearly and confidently in pleasant tone, pitch, and appropriate vocabulary that others can easily hear and understand

- Shapes information for a purpose and to appeal to the audience
- Uses notes and other memory aids to structure the presentation
- Uses visual aids to increase audience understanding, when appropriate
- Develops main points related to a single idea
- Engages the audience by using verbal cues and eye contact
- Projects a sense of individuality and personality

THE *EDC EARTH SCIENCE* APPROACH TO ASSESSMENT

Assessments are linchpins of teaching and learning. Used well, they provide powerful tools to inform your instruction so that your students develop rich, well-structured knowledge and scientific reasoning skills. Assessments come in a variety of forms, and should be **directly tied to clear learning goals.** These assessments are useful for a range of purposes, including:

1. **Evaluating the background knowledge** your students bring to each chapter.
2. **Monitoring students' progress** along the way so you can adjust instruction.
3. **Measuring students' achievement** of learning objectives at the end of each chapter.

Equally important is students' use of assessments. Assessments help keep learning goals in high relief, and provide critical feedback to students. In doing so, assessments empower students to take charge of their own learning.

The *National Science Education Standards* (NRC, 1996) made the early case that assessment tasks should "reflect what students are expected to learn; elicit the full extent of students' understanding; [be] set in a variety of contexts; have practical, aesthetic, and heuristic value; and have meaning outside the classroom" (p. 87). Quizzes and tests with multiple-choice and short-answer questions can be efficient measures of content knowledge, but other forms of assessment are necessary to promote learning of the complex relationships between concepts and the scientific practices identified in the *NGSS,* such as planning and carrying out investigations, engaging in argument from evidence, and obtaining, evaluating, and communicating information (NGSS, 2013). Using a variety of authentic assessments in the context of meaningful learning experiences can engage and motivate students. Such variety also allows those with diverse learning styles and abilities to show what they know and to excel in their schoolwork.

Learning goals are a particularly critical anchor point in extended learning experiences, such as those embodied in the chapters of *EDC Earth Science.* They bring a coherent purpose to the learning activities, and provide a framework against which progress can be measured. To be useful measures of learning and effective motivators of students' achievement, formative and summative assessments should always clearly relate to these learning goals.

Formative assessments are used during the learning process to identify when and where students are having difficulties, so that you can adjust the pace of instruction to allow more time for learning and/or to employ different teaching strategies to improve their understanding. Formative assessments based on clear learning goals also give students a chance to reflect on what they do and don't understand, and to identify personal strategies for improving their performance. They can include:

1. Probing students' understanding during class discussions.
2. Reviewing and providing feedback to students' written responses to homework questions.
3. Formal quizzes.
4. Less formal "minute papers" in which students, at the end of class, write their thoughts about the question, "Do you still have questions about the material we covered today?" (UMass Office of Planning and Assessment, 2001)

Formative assessments should occur frequently—the ambitious goal should be to give students feedback that is "just-in-time, just-for-me information delivered when and where it can do the most good" (Brookhart, 2008, p. 1).

Summative assessments occur at the end of a chapter, unit, or course, and measure the learning that has occurred. In addition to providing a cumulative measurement for grading purposes, summative assessments can give students a valuable opportunity to review and synthesize what they have learned.

Summative assessments, like formative ones, may take various forms:

1. Tests with selected-response and short-answer questions are efficient for assessing content knowledge, and can, in some cases, uncover persistent misconceptions.
2. Open-response questions can yield more information about students' reasoning skills.