5

Using Projects and Performances to Check for Understanding

Many of us recall participating in a classroom performance during our school years. It may have been a school play or a science fair. Perhaps you created a diorama in a shoebox illustrating the landing of the Pilgrims on Plymouth Rock. You may have constructed an animal cell out of Jell-O or built a model of a medieval castle. Whatever the project, it has undoubtedly lodged itself in your memories of school. Why are these activities so memorable? Because you were deeply invested in the outcome, you committed quite a bit of time and effort to the project or performance, and you recognized how different this was from the bulk of the assignments at which you toiled away every day.

The opportunity to apply learning to a novel situation hastens the transfer of learning. This concept is discussed often in educational courses but rarely realized in typical classroom settings. Although Bloom is well known for his work on a taxonomy of knowledge (see Chapter 3), what is sometimes overlooked is that one of the purposes of this system was to define ways in which a transfer of learning could occur. Tasks associated with application, analysis, synthesis, and evaluation are frequently designed as projects or performances. Many of these simply could not be accomplished by filling out a worksheet or answering multiple-choice questions. Ultimately, we must witness how our students choose and use information while taking part in a meaningful activity. When we view these events as opportunities

to check for understanding and not just task completion, we gain insight into the extent to which our students have transferred their learning to new situations.

In addition to using oral language, questioning techniques, and writing, effective teachers incorporate projects and performances in their classrooms to determine students' understanding of the content. In this chapter, we focus on project- and problem-based learning and the outcomes from these initiatives in terms of documenting and analyzing student learning. Barron and colleagues (1998) refer to this kind of learning as "doing with understanding" (p. 271).

Misuses of Projects and Performances in the Classroom

To use projects and performances as a tool to determine students' understanding, it is necessary to move beyond the traditional view of culminating projects. These tasks should be seen as more than just a fun or rewarding payoff for having learned all that stuff. Nancy's high school experience of representing rough endoplasmic reticulum in animal cells with uncooked lasagna noodles in Jell-O was certainly fun and memorable. Unfortunately, this fun experience did not result in her ability to recall the purpose of the endoplasmic reticulum (it synthesizes proteins). Doug's experience in making tribal masks and baskets in his 3rd grade unit of study on local Native American populations resulted in a lot of papier-mâché art but not much understanding of the role that these items played in the daily life of the Kumeyaay. In these cases, it's likely that the "doing" part took precedence over the "understanding" part (Barron et al., 1998).

Home–school communication is essential when assigning and evaluating projects. We have seen models of California missions constructed by architect mothers and volcanoes with hydraulics installed by engineer fathers. Subsequent conversations with students reveal that they had little to do with the design or execution of the project, and as a result, they possess a limited understanding of the historical, mathematical, or scientific concepts the project was designed to foster. While we appreciate the efforts of well-meaning parents who stay up late to complete a project, it is important that they understand the intent of the assignment. After all, teachers are checking not for the parents' understanding of California history or earth science but the children's.

Design Principles for Projects and Performances

To maximize the potential of projects and performances to check for understanding, they must be carefully designed. Barron and colleagues (1998) describe four design principles necessary for learning to occur: "learning-appropriate goals, scaffolds for student and teacher learning, frequent opportunities for formative assessment and revision, and social organizations that promote participation" (p. 273).

Learning-Appropriate Goals

This first principle of design refers to the essential question you want your students to address. An essential question should cultivate a sense of curiosity and motivate students to seek answers. Essential questions should be open-ended and thought-provoking and not answerable with a simple yes or no (Wiggins & McTighe, 2005). For instance, Nancy may have better understood the functions of the organelles of an animal cell if the essential question had been "What are the common structures and functions of diverse organisms?" rather than "Can you build an animal cell from Jell-O?" Doug may have better understood the meaning of masks in Native American life if he had been furnished an essential question such as "How do humans celebrate?"

Scaffolds for Student and Teacher Learning

Most of us have learned that before engaging in a major project, it is wise to pilot a smaller version. In educational research, pilot surveys are administered to discover potential problems. Business organizations discuss "sending up a trial balloon" or "testing the waters" before launching an expensive endeavor. In similar fashion, Barron and colleagues (1998) advise providing students with a problem-based learning experience before assigning a major project. This primes students for potential difficulties and focuses their attention on the more pertinent conceptual aspects of the project. In addition, it scaffolds their understanding and provides useful feedback for the teacher, allowing misconceptions and poorly defined parameters to be addressed before too much time and effort have been invested. Moore and colleagues (1996) describe a study in which some students completed a problem-based case study simulation on writing business plans before executing one themselves.

The students who participated in the problem-based learning outperformed those who did not.

Frequent Opportunities for Formative Assessment and Revision

Projects and performances often demand a heavy investment of time and effort. Needless frustrations result when students have made that investment in good faith, only to discover that their end result misses the mark. More often than not, there were no systems in place to have work in progress assessed for revision.

We build incremental assessments into our project-based assignments to prevent these difficulties. For example, we assign a photo essay to our 9th grade writing class (Frey, 2003). This is quite an undertaking, and students' interest and enthusiasm run high. However, because we know the assignment is fraught with potential problems, we meet with each student several times over the course of the project. Students develop a storyboard, draft text, and assemble the final product. At each stage, we confer with them and complete a checklist (see Figure 5.1). In addition, we use a mutually constructed rubric at each stage so that they can gauge the level of completeness of their project (see Figure 5.2). These checklists and notes from our meetings are turned in with the final project. Of course, these tools can be modified for use with students with disabilities and for students who find school difficult.

Social Organizations That Promote Participation and a Sense of Agency

Many projects and performances involve group collaboration, and these instructional arrangements can be a source of frustration when not carefully designed and monitored. A common element in the findings about successful cooperative learning groups is that there should be both group and individual accountability (Cohen, 1994; Johnson & Johnson, 1998). Therefore, it is wise to provide students with a mechanism for evaluating their own performance in the group. We have included a sample self-assessment in Figure 5.3.

Projects that are completed individually may benefit from inviting peer feedback, which can be valuable for all students. Anyone engaged in a creative endeavor knows how useful it can be to run an idea past a trusted colleague.

Figure **5.1**

Feedback for Draft Photo Essays

Feedback on Draft of Photo Essay

Student: _____ Date: _____ Draft # _____

CATEGORY	RESPONSIBILITIES
Conventions	☐ My paragraphs have more than one sentence. ☐ Each of my paragraphs has one main idea. ☐ I have used correct grammar. ☐ I have used correct punctuation. ☐ I have checked my spelling. ☐ I have used capital letters correctly. ☐ My handwriting is legible.
Organization	☐ My introduction is interesting and inviting. ☐ The sequence of ideas is logical. ☐ My ideas flow from one to another. ☐ I use helpful transitions between main points (e.g., "First of all" or "Similarly"). ☐ I have a satisfying conclusion.
Flow	☐ My sentences build logically upon the one(s) before. ☐ My sentences are different lengths. ☐ My sentences start in different ways. ☐ There are no run-on sentences. ☐ There are no incomplete sentences.
Punctuation	☐ Commas separate items in a series. ☐ A comma follows an introductory word or phrase. ☐ A semicolon connects two sentences. ☐ Closing quotation marks always follow commas or periods. ☐ Apostrophes are used correctly to show possession or to create contractions. ☐ A period, question mark, or exclamation point ends every sentence.
Word Choice	☐ I use descriptive words (adjectives and adverbs) often. ☐ I use strong, active verbs. ☐ I use synonyms and different words to add variety. ☐ My pronouns match the nouns to which they refer.

Next Steps:

From "A picture prompts a thousand words: Creating photo essays with struggling writers," by N. Frey, 2003, *California English, 8*(5), 20.

Figure 5.2 **Rubric for Photo Essay**

Student Name: _____ Date: _____ Title: _____

Category	4	3	2	1
Required Elements	Photo essay included all required elements as well as a few additional ones.	Photo essay included all required elements as well as one additional element.	Photo essay included all required elements.	One or more required elements were missing from the photo essay.
Spelling and Grammar	Few or no spelling or grammatical mistakes on a photo essay with lots of text.	Few or no spelling or grammatical mistakes on a photo essay with less text.	Several spelling or grammatical mistakes on a photo essay with lots of text.	Several spelling or grammatical mistakes on a photo essay with little text.
Use of Time	Used time well during each class period with no adult reminders.	Used time well during most class periods with no adult reminders.	Used time well but required adult reminders on one or more occasions.	Used time poorly in spite of several adult reminders.
Content	Photo essay uses both text and pictures to tell an imaginative story.	Photo essay uses mostly text, with some support from pictures, to tell an imaginative story.	Some pictures and text are not clearly related to one another.	Text and pictures have little connection with one another.

Required Elements:

- ☐ 15–20 photographs used in photo essay.
- ☐ Text is typed or written neatly.
- ☐ Photo essay includes a cover with title, author, and illustration.
- ☐ "About the Author" essay included.

From "A picture prompts a thousand words: Creating photo essays with struggling writers," by N. Frey, 2003, *California English, 8*(5), 21.

Peer response in the classroom can offer the same advantages, but the skills required for offering and accepting need to be taught. In particular, we remind our students of the following principles:

- Students determine when they need peer feedback. We don't construct an artificial schedule of when students are required to get peer feedback, only that they do so at some point during the project.

Figure 5.3 **Self-Assessment of Group Work**

Name: _____
Date: _____
Project: _____

Members of my group:

_____
_____
_____

Please rank yourself based on your contributions to the group. Circle the number that best describes your work.

5 = Always 4 = Almost Always 3 = Sometimes 2 = Once or Twice 1 = Never

I completed my tasks on time.	5	4	3	2	1
I contributed ideas to the group.	5	4	3	2	1
I listened respectfully to the ideas of others.	5	4	3	2	1
I used other people's ideas in my work for the project.	5	4	3	2	1
When I was stuck, I sought help from my group.	5	4	3	2	1

Additional comments:

From *Language arts workshop: Purposeful reading and writing instruction* (p. 403), by N. Frey and D. Fisher, 2006, Upper Saddle River, NJ: Pearson/Merrill/Prentice Hall.

- Not everything needs peer feedback. Too much feedback can result in an overload of information.
- Teachers, not students, should offer feedback on the details and mechanics of the piece. Peer response should not turn classmates into miniature teachers. Instead, peers can provide reactions as a fellow reader, writer, or audience member related to what they understood and what might be confusing (Frey & Fisher, 2006).

Problem-Based and Project-Based Learning

Both problem-based and project-based learning (PBL) can be integrated into performances. These approaches seek to replicate an authentic experience or application that occurs outside the classroom. Most experiences are designed to be collaborative, resulting in social as well as academic learning. Both problem-based and project-based learning are intended to integrate skills and content across disciplines, resulting in a holistic experience.

Although the approaches are similar, there are some differences between the two. Project-based learning is more common to elementary and secondary classrooms; problem-based learning is used less frequently (Esch, 1998). Problem-based learning is used widely in the medical field, where case studies serve as an important method for developing the skills of novices (Hmelo, 1998). Because problem-based learning is, by design, authentic to the situation, young students are more limited in their ability to successfully complete these complex assignments. Therefore, project-based learning, where a multidimensional task is defined and supported, is used more frequently in K–12 classrooms.

Projects can extend from a few days in length to weeks or even a semester, with even young children finding success. For example, project-based learning has been used in inclusive 5th and 6th grade classrooms to teach historical understanding (Ferretti, MacArthur, & Okolo, 2001). While the potential of project-based learning is appealing, Meyer, Turner, and Spencer (1997) offer cautions regarding the design of such learning experiences. Having noted that some students have less capacity for dealing with setbacks and other challenges, they state that "typical classroom goals such as accuracy, speed, and completion dates may conflict with the project-based math goals of justification, thoughtfulness, and revision" (p. 517). Keep in mind some of the design principles discussed earlier, especially access to frequent formative assessments to guide revisions. These, along with structures such as timelines and intermediate goals, can be especially helpful for students who are less persistent or who like their work to be perfect before the teacher sees it.

Performance Learning

A third type of learning opportunity used frequently in the classroom is performance, which can be presented through public or other visual means. Many performances focus on the application and synthesis of knowledge to create novel products. Like project-based learning, there is an end product in mind (e.g., a poster, a Web-based project, a musical). Not all performances are as elaborate as problem- and project-based learning (PBL) assignments. Some are simpler and do not need all of the formal supports associated with PBL. For example, the creation of a graphic organizer to visually represent the influence of Muslim scholars on scientific processes, mathematics, and literature is not likely to require a series of formative assessments along the way.

The importance of performance opportunities lies in their potential for providing other outlets for students to demonstrate their mastery of different concepts in ways that are not limited to more traditional school-based demonstrations such as reading, writing, and computational tasks. In many ways, performance tasks lie at the heart of differentiated instruction because they afford learners with diverse needs creative ways to show competence (Tomlinson, 1999).

In the next section, we will discuss techniques for using performances and projects to check for understanding. All of them use principles of design discussed earlier, especially scaffolds and group interactions. Although many are public performances, some are transactions between the teacher and learner only.

Effective Techniques Using Projects and Performances

Readers' Theatre

Readers' Theatre is a classroom activity in which students read directly from scripts to tell a story or inform an audience. They do so without props, costumes, or sets. Readers' Theatre is first and foremost a *reading* activity, and students do not memorize their lines. They are, however, encouraged to use intonation, facial expression, prosody, and gestures appropriate to their characters and their characters' words. Readers' Theatre can be done with narrative or informational texts. The point is that students perform the reading.

Readers' Theatre enjoys a long history and a fairly strong research base. Readers' Theatre has been used to improve reading fluency, vocabulary knowledge, and comprehension (Doherty & Coggeshall, 2005; Flynn, 2004; Martinez, Roser, & Strecker, 1998–99). There are a number of ways that teachers can obtain Readers' Theatre scripts. The easiest way to find these is to type "readers' theatre scripts" into a Web search engine.

Using preproduced scripts will develop students' literacy skills, especially in the areas of fluency, vocabulary knowledge, and comprehension. However, preproduced scripts are not as useful in checking for understanding (unless you're evaluating fluency, for example). One way to use Readers' Theatre to check for understanding is to have small groups of students take a piece of text and turn it into a script. This allows the teacher to determine if the group (or individual students, for that matter) understands the main ideas of the texts. Alternatively, teachers can check students' understanding of specific content information using this method.

Sixth grade teacher Darleen Jackson uses Readers' Theatre to check for understanding of content. At one of the learning centers in her classroom, students create scripts from informational texts. The texts are selected based on the major units of study occurring at the time and represent a wide readability range. During their unit of study on ancient Egyptians, one group selected the book *Ancient Egypt* (Langley, 2005). They knew that they had to write their script, summarizing the main parts of the section they chose to read, and present the Readers' Theatre as a transition activity. Part of their performance is shown below:

Narrator: The earliest Egyptians lived in villages.
Egyptian Man 1: We decided to live in a small community.
Egyptian Man 2: It's safer when we live in a small community. Then we're not attacked by bandits or thieves.
Egyptian Man 1: We also can divide up the work. I'm a craftsman and make pottery.
Egyptian Man 2: I'm a trader who buys and sells things to keep our products moving along the Red Sea.
Egyptian Woman 1: There's no mention of what I'm doing for work, probably just taking care of the house and babies.

Narrator: Each small community developed their own leaders and religions.

When she listened to the group's Readers' Theatre presentation, Ms. Jackson knew that her students were developing an understanding of life in ancient Egypt. She was pleased that they questioned the role of women in ancient Egypt but wanted to be sure that they understood the development of commerce in this society. She planned to subsequently meet with this group and have them summarize their understandings to date.

Multimedia Presentations

Multimedia presentations provide learners an opportunity to share what they know as they combine text, graphics, video, sound, and even animation. Although such projects were unthinkable just a few years ago due to the costs of hardware and software involved, students today can produce complex products. The digital revolution has provided students with new ways of demonstrating their knowledge and has given teachers new ways of checking for understanding (Armstrong & Warlick, 2004). Research and practical evidence supporting the use of multimedia in the classroom are growing (Bremer & Bodley, 2004; Weiss, Kramarski, & Talis, 2006). There is evidence that multimedia projects facilitate student learning and provide students who are traditionally considered "at risk" with opportunities to demonstrate their knowledge (Garthwait, 2004; Maccini, Gagnon, & Hughes, 2002; Zydney, 2005).

Fourth grade teacher Michael Kluth spends much of the school year focused on the human body and its systems. Over the year, students develop and present several PowerPoint presentations. Mr. Kluth's students have to read widely about body systems they've selected in order to develop their understanding of the systems and to create their presentations. Mr. Kluth knows that these multimedia presentations allow him to check his students' understanding of the human body. He also knows that the projects enable his students to practice their listening and speaking skills. Groups present a body system each month and listen to at least 10 other presentations during that time (some of his students are in the library conducting their research while others are presenting). During these listening opportunities, students take Cornell notes (Frey & Fisher, 2007). This continual review of body

systems and the cumulative knowledge students gain from developing their own multimedia presentations, as well as from listening to and taking notes on the presentations of others, allow Mr. Kluth the opportunity to evaluate his students in a meaningful way. As Mr. Kluth says, "The first set of presentations is just okay. They learn more for each system they complete and incorporate what they've learned from others. I can listen to the presentation and provide feedback on the content, common misconceptions, and their developing language skills."

Consistent with the appropriate use of a rubric, Mr. Kluth and his students review the criteria on which they are judged. Students should have an understanding of the multimedia project and performance rubric before they are given feedback. A sample rubric can be found in Figure 5.4.

Students in the Academy of Informational Technology, a school-within-a-school at Hoover High School in San Diego, created digital videos as a culminating project for several of their classes taught in an interdisciplinary format. The teachers chose to participate in the "My City Now" National Media Literacy Program (www.mycitynow.org). Students were assigned to make their own three-minute documentary about the past, present, or future of the city they live in. They were matched with senior citizens from the community to interview and were provided time in class and after school to work on their productions. The national winner for 2006 was Jonathan, a 14-year-old Hoover High School student who produced and directed a video titled *The Painting of a Culture.*

Jonathan's video highlighted Chicano Park in San Diego and its amazing murals. In fewer than three minutes, Jonathan documented the rise of a hardworking immigrant culture. According to his teachers, "Jonathan really demonstrated his understanding of the national immigration discussion. He did something with his understanding that will impact lots of people."

Electronic and Paper Portfolios

A portfolio is a collection of items intended to reflect a body of work. Architects and artists assemble professional portfolios to show clients their best work and to demonstrate their range of expertise. Educational portfolios differ slightly from those used by professionals in that they are designed to reflect a student's process of learning (Tierney, 1998). They are not meant to serve as a scrapbook of random ephemera gathered during the school year. At their best, they can provide another

Figure 5.4 **Multimedia Project and Performance Rubric**

	4	3	2	1
Organization	Student presents information in a logical, interesting sequence that the audience can follow.	Student presents information in a logical sequence that the audience can follow.	Audience has difficulty following presentation because student does not consistently use a logical sequence.	Audience cannot understand presentation because there is no sequence of information.
Subject Knowledge	Student demonstrates full knowledge (more than required) by answering all class questions with explanations and elaboration.	Student is at ease and provides expected answers to all questions but fails to elaborate.	Student is uncomfortable with information and is able to answer only rudimentary questions.	Student does not have grasp of information; student cannot answer questions about subject.
Graphics	Student's graphics explain and reinforce screen text and presentation.	Student's graphics relate to text and presentation.	Student occasionally uses graphics that rarely support text and presentation.	Student uses superfluous graphics or no graphics.
Mechanics	Presentation has no misspellings or grammatical errors.	Presentation has no more than two misspellings and/or grammatical errors.	Presentation has three misspellings and/or grammatical errors.	Student's presentation has four or more spelling errors and/or grammatical errors.
Eye Contact	Student maintains eye contact with audience, seldom returning to notes.	Student maintains eye contact most of the time but frequently returns to notes.	Student occasionally uses eye contact but still reads most of report.	Student reads all of report with no eye contact.
Elocution	Student uses a clear voice and correct, precise pronunciation of terms so that all audience members can hear presentation.	Student's voice is clear. Student pronounces most words correctly. Most audience members can hear presentation.	Student's voice is low. Student incorrectly pronounces terms. Audience members have difficulty hearing presentation.	Student mumbles, incorrectly pronounces terms, and speaks too quietly for students in the back of class to hear.

From "Evaluating student presentations," by C. McCullen, 1997, Information Technology Evaluation Services, N.C. Department of Public Instruction. Retrieved February 7, 2007, from www.ncsu.edu/midlink/rub.pres.html.

way to check for understanding. However, this requires that the student choose the evidence that best illustrates his or her cognitive processes (Frey & Hiebert, 2003). An added benefit of portfolios is that they can involve parents in the process of checking their child's understanding (Flood & Lapp, 1989).

A challenge of portfolio creation is making decisions about what should be used. Wilcox (1997) proposes a model for portfolios that emphasizes the cognitive processes of learning, suggesting that the following items be included:

- Reading artifacts that make connections through reading, such as diagrams, outlines, and summaries.
- Thinking artifacts that construct our knowledge base, such as mind maps, steps to problem solving, and responses to prompts.
- Writing artifacts that make meaning through writing, such as self-evaluations, a publication piece, and reflections on a learning experience.
- Interacting artifacts that share and scaffold ideas, such as peer assessments, brainstorming charts, and a problem and solution.
- Demonstrating artifacts that show application and transfer of new learning, such as a project or exhibition. (p. 35)

Portfolios can be electronic or in a traditional paper-based format, usually stored in three-ring binders. Paper portfolios are generally easier for younger children to handle, as they can easily add new items and remove others with little assistance from an adult. Digital portfolios are increasingly used with older students, especially because this format has become essential to 21st-century classrooms. Experiences with the design and assembly of digital presentations also prepare students to create the electronic portfolios expected in higher education and the workplace.

Navigating the creation and maintenance of portfolios, whether paper or digital, with students can be tricky. Barrett (2006) tells the story of high school students who gathered after graduation to burn their portfolios. On the one hand, students need guidance in developing portfolios; on the other, the question of ownership in such a personal expression can be negatively affected by the required nature of many such assignments. The balance lies in teaching about types of artifacts, as suggested by Wilcox, and resisting formulaic approaches that require students to furnish three examples of this and four examples of that. The danger

of such prescriptive portfolio assignments is that portfolios are reduced to filling in the blanks, thus reducing checking for understanding to task completion only.

Eighth grade teacher Tahira Birhanu taught her English class the basics of electronic portfolios at the beginning of the year so that students could choose to create them as a method for demonstrating their understanding of the works read and discussed in class. Her students know that a title card, table of contents, and buttons to activate links to sections of the portfolio are a must. Her primary interest is in analyzing the reflective and elaborative pieces the students include explaining the reading, writing, thinking, interacting, and demonstrating artifacts selected for the portfolio. One of the students in her class, Madison, chose to construct an electronic portfolio to explain her work with her literature circle, which had read *Project Mulberry* (Park, 2005). The story of a Korean American girl who rebels against being stereotyped as obedient and studious resonated with Madison, and she was eager to write about her thoughts. She included a collage comprising images captured from the Internet that represented the conflict the protagonist experienced. Madison also located links to Web sites that explained how silkworms are raised, since they become the focus of the science project discussed in the book. In addition to the collage and information, Madison included examples of notes she took during her reading and samples from the journal she kept for her literature circle group.

One of the reflective pieces that Madison wrote about regarding taking notes was included in her portfolio:

> When I heard we had to write notes as we read, all I could think of was, "Busy work!" I'm a good reader, and I don't need to be assigned reading to get into a good book. Taking notes was just going to slow me down. But when I reread some of my notes from earlier in the book, I could see how much my thinking had changed. I noticed that at the beginning of the book I thought that Julia was right to dislike anything that was "too Korean." My mom's always making me listen to all these old stories about people I hardly know. But when I read my notes for this project I started thinking about how maybe I wasn't being fair to my mom, just like Julia wasn't being fair to hers.

Ms. Birhanu was pleased to see how Madison had turned a reading artifact (her notes) into a demonstration of her transfer of learning.

Visual Displays of Information

In their book *Classroom Instruction That Works,* Marzano, Pickering, and Pollock (2001) describe visual displays (they call them "nonlinguistic representations") as "the most underused instructional strategy of all those reviewed" (p. 83). This is unfortunate, because the authors' meta-analysis of pertinent studies yielded a 0.75 effect size and a percentile gain of 28 on test scores. Visual displays of information require students to represent knowledge in a nonlinguistic fashion, typically using images or movement to do so. There is evidence that students who generate visual representations of a concept are better able to understand and recall the concept (Ritchie & Karge, 1996). Edens and Potter (2003) studied 184 4th and 5th graders who were learning about the law of conservation of energy. Those randomly assigned students who generated drawings scored higher on a test of conceptual knowledge and possessed fewer misconceptions than their peers who wrote in a science journal. They also noted in their study that the drawings themselves served as another means for assessing misconceptions and inaccuracies. It is likely that the use of visual representations of understanding assist the learner in building mental models (Mayer & Gallini, 1990). We discuss four types of visual representations below.

Graphic organizers. These are one of the most common and well-researched tools used in reading comprehension (Moore & Readence, 1984). Graphic organizers have been effectively used across the content areas, including in English and language arts (Egan, 1999), math (Monroe & Pendergrass, 1997), science (Carlson, 2000), and social studies (Landorf & Lowenstein, 2004). We know that graphic organizers are effective with students with disabilities (Dye, 2000; Kooy, 1992), students who are gifted and talented (Cassidy, 1989), English language learners (Levine, 1995) and across the grade spans of elementary school, middle school, high school, and college learners (Gonzalez, 1996; Hobbs, 2001; Williams et al., 2005).

While the instructional implications for graphic organizers are clear, the role that these visual representations play in assessment is less so. When teachers are checking for understanding, it seems reasonable to suggest that asking students to create a visual representation of their knowledge would be valuable. We're not suggesting that teachers learn to assess or evaluate the graphic organizers (e.g., how

well the web is drawn) but rather that we use the construction of graphic organizers as a source of information to determine what students know and do not know.

As we have learned from the evidence on thinking maps (see, for example, www.thinkingmaps.com), students need to be taught to use a variety of visual tools and graphic organizers. We believe that this is necessary regardless of whether graphic organizers are used for instruction or to check for understanding. Simply photocopying a graphic organizer and requiring that students fill it out will not ensure deep learning or provide an authentic assessment opportunity (Egan, 1999; Frey & Fisher, 2007). Figure 5.5 contains a list of various types of graphic organizers and thinking maps with which students should be familiar.

Physics teacher Jesse Nunez uses graphic organizers in his class to check his students' understanding of content. He teaches his students a number of tools early in the school year and then invites them to use different tools to demonstrate their content knowledge. He does not provide photocopies of graphic organizers or require that students all use the same graphic organizer at the same time. During their unit of study on states of matter, Arian created a concept map explaining her knowledge of solids, liquids, and gases (see Figure 5.6). Mr. Nunez reviewed Arian's concept map and noted that she understood each of the three states of matter but wondered if she comprehended the interactions and relationships between and among these states of matter.

Inspiration. Like many things in our world, graphic organizers can also go digital. The Inspiration and Kidspiration software programs allow users to create visual tools—graphic organizers—on the screen (see www.inspiration.com for information). Current versions of the software allow users to import text, transform ideas and graphics, and select from a range of graphic organizers and tools.

Royer and Royer (2004) wondered if there was any difference in the complexity of the concept maps students would create if they had access to computers to complete the tasks. They compared the graphic organizers created by 52 students in biology classes that used either paper and pencil or computers with Inspiration software. Their findings suggest that there are significant positive outcomes when students create graphic organizers in a digital environment. Mastropieri, Scruggs, and Graetz (2003) document similar results and make similar recommendations for students who struggle with reading or who have disabilities.

Figure 5.5

Graphic Organizers and Definitions

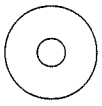
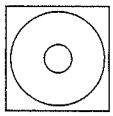
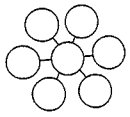
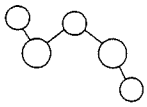
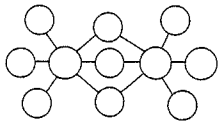
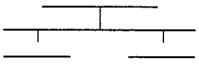
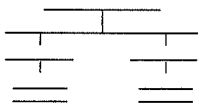
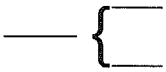
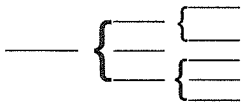
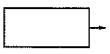
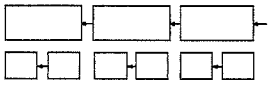
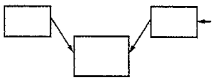
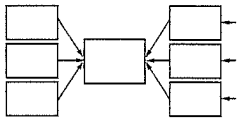
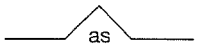
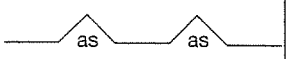
primitives	Thinking Maps and the Frame	expanded maps
	The Circle Map is used for seeking context. This tool enables students to generate relevant information about a topic as represented in the center of the circle. This map is often used for brainstorming.	
	The Bubble Map is designed for the process of describing attributes. This map is used to identify character traits (language arts), cultural traits (social studies), properties (sciences), or attributes (mathematics).	
	The Double Bubble Map is used for comparing and contrasting two things, such as characters in a story, two historical figures, or two social systems. It is also used for prioritizing which information is most important within a comparison.	
	The Tree Map enables students to do both inductive and deductive classification. Students learn to create general concepts, (main) ideas, or category headings at the top of the tree, and supporting ideas and specific details in the branches below.	
	The Brace Map is used for identifying the part-whole, physical relationships of an object. By representing whole–part and part–subpart relationships, this map supports students' spatial reasoning and understanding of how to determine physical boundaries.	
	The Flow Map is based on the use of flowcharts. It is used by students for showing sequences, order, timelines, cycles, actions, steps, and directions. This map also focuses students on seeing the relationships between stages and substages of events.	
	The Multi-Flow Map is a tool for seeking causes of events and the effects. The map expands when showing historical causes and for predicting future events and outcomes. In its most complex form, it expands to show the interrelationships of feedback effects in a dynamic system.	
	The Bridge Map provides a visual pathway for creating and interpreting analogies. Beyond the use of this map for solving analogies on standardized tests, this map is used for developing analogical reasoning and metaphorical concepts for deeper content learning.	
	The Frame The "metacognitive" Frame is not one of the eight Thinking Maps. It may be drawn around any of the maps at any time as a "meta-tool" for identifying and sharing one's frame of reference for the information found within one of the Thinking Maps. These frames include personal histories, culture, belief systems, and influences such as peer groups and the media.	

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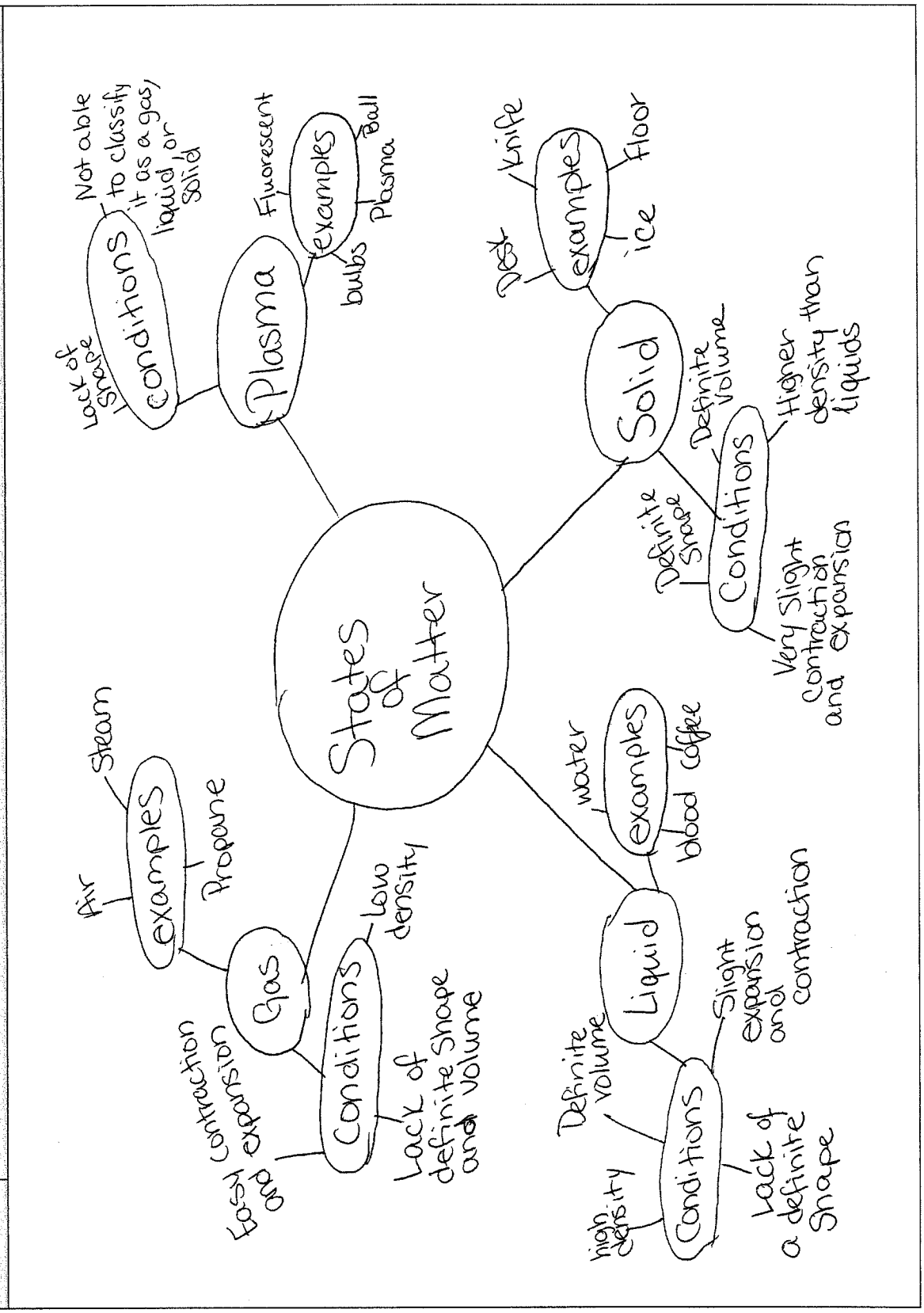
Figure **5.6** **Arian's Concept Map**



During their study of insects, complete and incomplete metamorphosis, and life cycles, the students in Jenny Olson's class spent time at a learning center creating visual representations of their understanding using Inspiration. Javier created the visual representation—a concept map—of complete metamorphosis found in Figure 5.7. Ms. Olson noticed that Javier had an understanding of the stages of complete metamorphosis and had collected some interesting details about each stage from the various books he had read. However, she also noted that his visual representation did not communicate the stage and cycle information critical to understanding the process of metamorphosis and the insect life cycle. She decided to meet with him and discuss his graphic organizer. Through questioning, she led Javier to understand how to represent his learning visually. She also had the opportunity to solidify his understanding that eggs become larvae, larvae become pupae, pupae become adults, and then the adults lay eggs.

Foldables. Foldables are three-dimensional interactive graphic organizers developed by Zike (1992). They provide students with a way of manipulating concepts and information in ways that are far more kinesthetic than ordinary worksheets. Paper is folded into simple shapes that reflect the conceptual relationships represented by the notes. Sixth grade social studies teacher Tim Valdes asked students to compare and contrast the Athenians and Spartans of ancient Greece. His students had been working with interactive graphic organizers since the beginning of the school year, so they were able to select their own way of representing this information. Arturo chose to make a three-tab book with a Venn diagram drawn on the front. Under each flap, he wrote information about both city-states. Arturo's choice of an organizer and the information he included gave Mr. Valdes insight into the knowledge his student possessed, as well as the mental model he used. Arturo's Foldable is represented in Figure 5.8.

Dioramas. Though some believe dioramas are old-fashioned, we are proponents of dioramas as a method of performance. Unlike the dioramas of our youth, which tended to emphasize the composition of the final product over the learning invested in its development, the potential of a diorama is akin to any other visual representation of knowledge. Dioramas are miniature models of a scene from the physical, social, biological, or narrative world, traditionally built inside a shoebox turned on its side. We prefer to use the Foldables four-door diorama shown in Figure 5.9

Figure 5.7 **Javier's Concept Map**

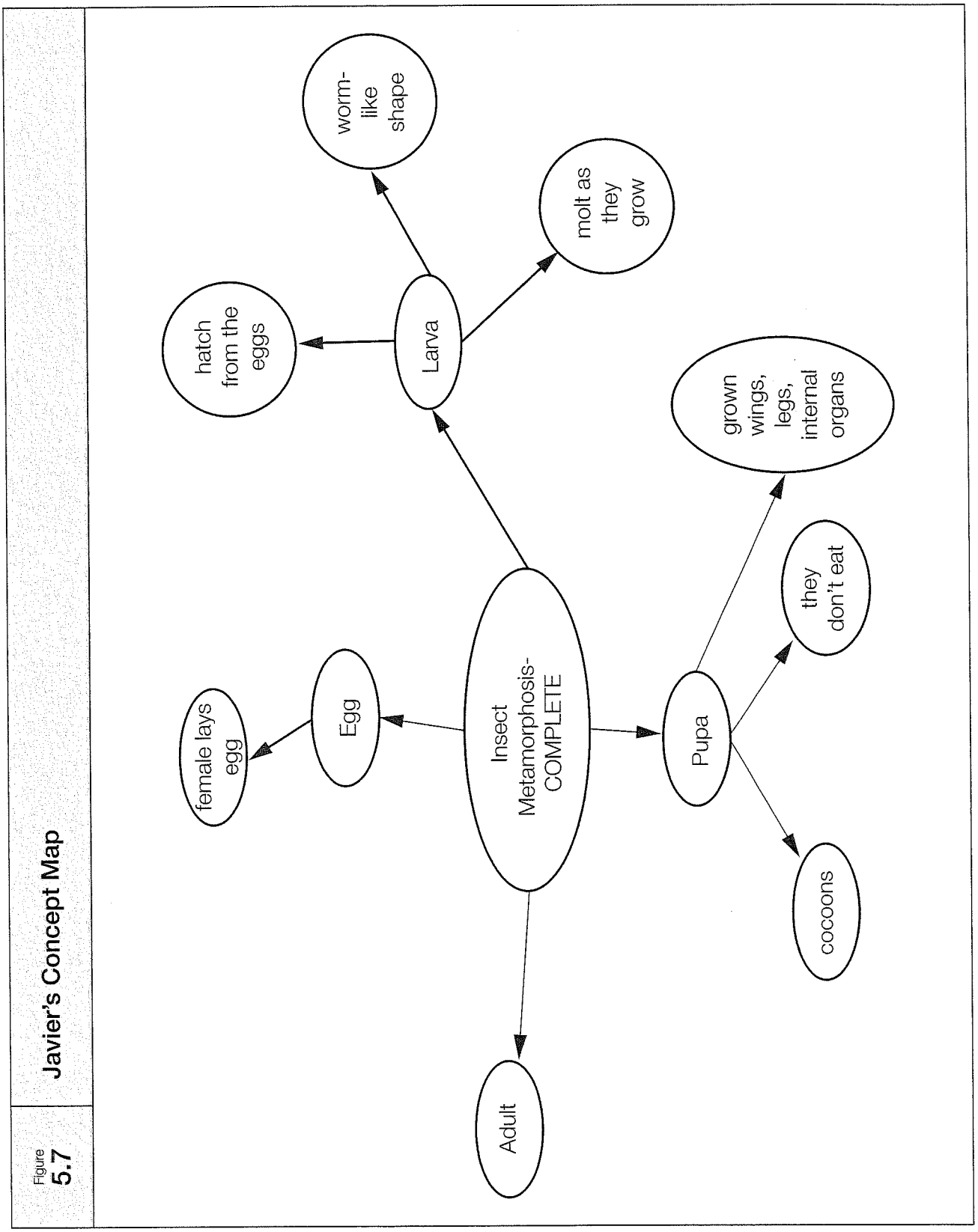
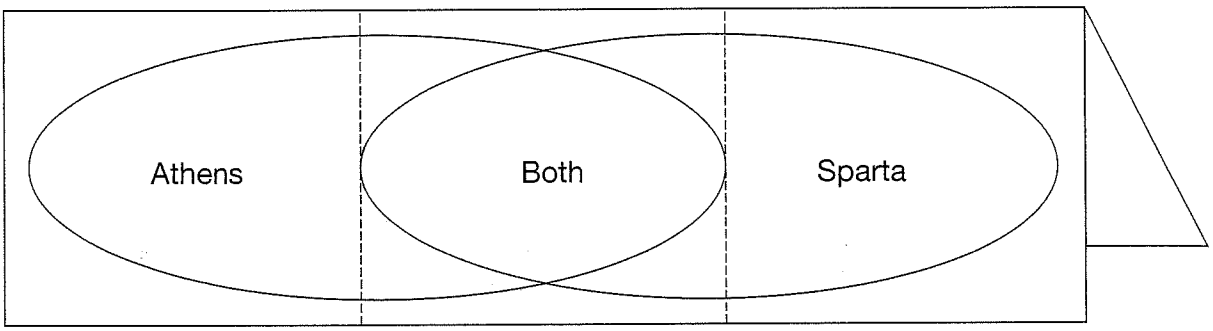


Figure 5.8 **Arturo's Foldable**

Front cover view



Inside contents

Athens	**Both**	**Sparta**
elected ruler	in Greece	kings
peaceful	city-states	warlike
arts and theater	enslaved people	combat & sports
democracy	powerful for a while	oligarchy

because it offers the student more options in the size of the diorama (they can use anything from 11" × 17" paper up to poster board size).

Louis Daguerre, the inventor of the daguerreotype, was the first to conceive the use of dioramas. He was a set designer by trade, and he developed large-scale dioramas (more than 20 feet in length) for public display, their subject usually an architectural wonder (Maggi, 1999). Using a *chiaroscuro* painting technique (i.e., the arrangement or treatment of light and dark parts in a pictorial work of art) and lighting methods learned in the theater, Daguerre introduced the world to a unique style of visual storytelling.

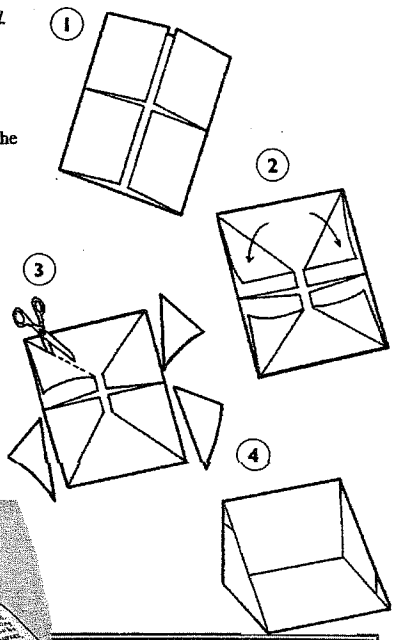
Figure 5.9

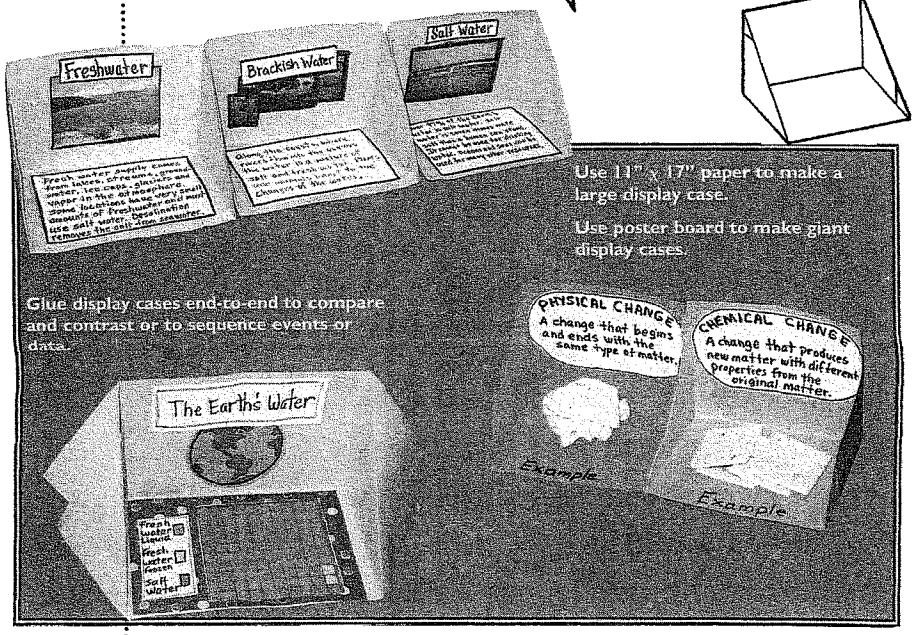
Four-Door Diorama

FOLDING INSTRUCTIONS: ANY NUMBER OF PARTS

Four-Door Diorama

1. Make a *four-door book* out of a *shutter fold.*
2. Fold the two inside corners back to the outer edges (*mountains*) of the *shutter fold.* This will result in two *tacos* that will make the *four-door book* look like it has a shirt collar. Do the same thing to the bottom of the *four-door book.* When finished, four small triangular *tacos* have been made.
3. Form a 90-degree angle and overlap the folded triangles to make a display case that doesn't use staples or glue. (It can be collapsed for storage.)
4. Or, as illustrated, cut off all four triangles, or *tacos.* Staple or glue the sides.





36

Adapted from *Dinah Zike's big book of science: Elementary K–6* (p. 36), by D. Zike, 2004, San Antonio, TX: Dinah-Might Adventures, LP, www.dinah.com.

It is this visual narrative that offers a way of checking for understanding. By examining the information represented in the diorama, as well as talking with students about how they represented the information, you can check for their understanding of the concepts. Third grade teacher Belinda Mullins uses dioramas as a way for students to demonstrate what they have learned about animals they have researched in science. Emily chose to learn about the Mexican free-tailed bat. She constructed a diorama that included a drawing of a small brown bat flying out of a cave. Emily hung the bat drawing from a piece of yarn attached to the top of the diorama to represent flight, and she lined the inside of the box with black construction paper. She glued small "googly eyes" purchased from a craft store at the opening of the cave. Tiny drops of brown puff paint dotted the inside of the display. She explained to Ms. Mullins that this bat lives in caves and flies at night. Some caves are filled with millions of Mexican free-tailed bats, making them some of the largest colonies on Earth (that's what the "googly eyes" were for). Ms. Mullins told Emily that she understood that the black construction paper represented the night sky, but what were the brown dots of paint meant to be? Emily replied, "Those are the mosquitoes they eat every night!" By making sure that she met with Emily and each of her students, Ms. Mullins was able to check their understanding about the animals they had selected as the subject for their first science research project.

Public Performances

The act of performing publicly can be a memorable experience for students and teachers. As noted earlier in this chapter, public performances can also be used as a means for checking for understanding. McDonald (2005) has written of the value of student-created performances to gauge the learning of students in art; McDonald and Fisher (2002) addressed the same subject in music education. Podlozny's (2000) meta-analysis indicates that when students received instruction on public performance, there was an increase in comprehension and, to a lesser extent, reading achievement. In recent years, many high schools have begun to require public exhibitions of knowledge as part of the graduation requirements for seniors.

Rita Elwardi and Sheri Sevenbergen's students in their high school ESL classes engage in an extended public performance of their learning in an exhibition that has come to be known as "The Quilt Celebration." Their students come from every continent except Antarctica and Australia, and together they represent the range

of human experiences associated with immigration to America. Over the course of the year, students construct a quilt made of individual squares that visually represent their stories. They write poetry collaboratively for public performance at the celebration. Students discuss their transformation through learning and their plans to continue their education. The celebration is attended by a large audience of families, faculty, students, and community members. As you can imagine, the event is moving; audience members are sometimes brought to tears as they listen to the insightful comments of these adolescents. However, Ms. Elwardi and Ms. Sevenbergen also use these public performances as a way to check for understanding. As Ms. Elwardi notes, "They need to be able to tell their own stories, and to relate who they are and what they stand for to others. As new arrivals to this country, it's easy for them to become intimidated by the language. This event gives them an opportunity to tell their story more formally, which is practice for a lifetime of effective communication." The students wrote and performed several poems for the Quilt Celebration in 2006, one of which can be found in Figure 5.10.

Figure 5.10 **Poem from the Quilt Celebration**

I used to be a grain of sand,
caught in an oyster shell,
but now I am a pearl,
reflecting the luminous moon
of possible dreams.

I used to be a closed fist,
clenched in anger,
but now I am an open hand,
extending friendship.

I used to be a caterpillar,
always stuck on a leaf,
but now I am a butterfly—
flying for freedom and looking for love.

I used to be the starless night,
hiding my dreams in darkness,

but now I am a prism of light
illuminating my way into the future.

I used to be a hard lump of coal
under the ground,
but now I am a glittering diamond,
valuable and precious.

I used to be a blank piece of paper,
but now I am a journal full of ideas.

I used to be a moon,
sometimes full, sometimes half,
sometimes just a sliver of myself,
but now I am a star sending light
to unknown worlds.

I used to be a paper crane,
folded to resemble something real,
but now my wings take me
to the height of my hopes and dreams.

I used to be lead, held by a pencil,
but now I am the words,
bringing ideas to life on paper.

I used to be a seed,
fallen to the ground,
but now I am a giant tree
with branches that give others shade.

Conclusion

Projects and performances are an underused but critical method of checking for understanding. These displays offer students an opportunity to use new learning to create original works, allowing a transfer of learning to occur. By using the design principles put forth by Barron and colleagues (1998), teachers can ensure that more meaningful work is generated. While some tasks require extensive preparation for their execution, such as portfolios and public performances, many others, such as visual displays of information and Readers' Theatre, are easily integrated into daily classroom practice.