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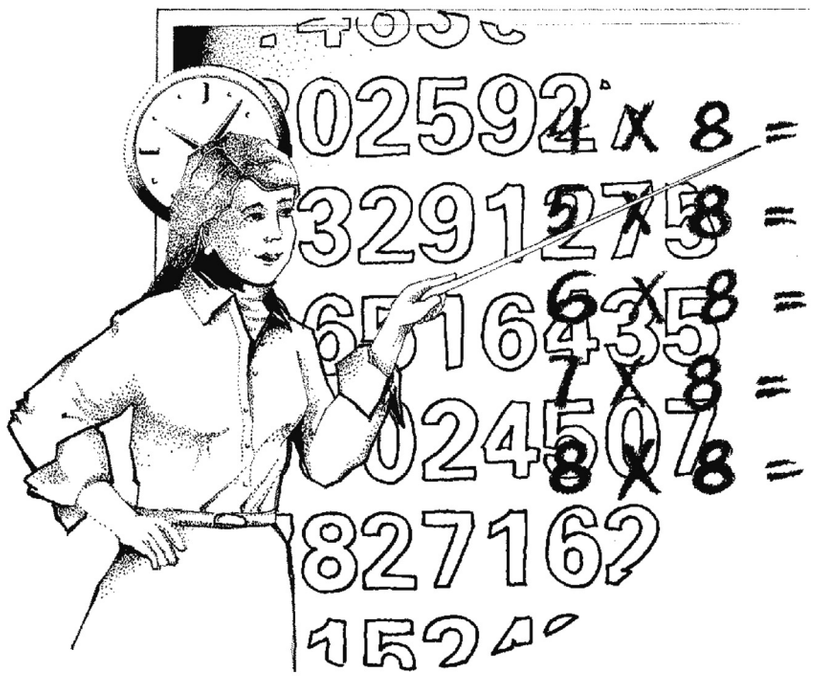
Performance-Based Learning and Assessment



In the act of learning, people obtain content knowledge, acquire skills, and develop work habits—and practice the application of all three to "real-world" situations. Performance-based learning and assessment represent a set of strategies for the acquisition and application of knowledge, skills and work habits through the performance of tasks that are meaningful and engaging to students.

—Educators in Connecticut's
Pomperaug Regional School District 15
(in Hibbard et al., 1996)

Performance assessment is assessment based on observation and judgment. The assessor observes a student perform a task or reviews a student-produced product, and then evaluates the quality of that task or product. While performance tasks can be designed to have students demonstrate their understanding through the application of acquired knowledge to a new and different situation, good performance tasks always involve more than one acceptable solution, often calling for students to explain or defend their solutions. Performance tasks are both an integral part of learning and an opportunity for assessing student performance quality (Arter & McTighe, 2001).

Assessment and accountability standards have long been quantified through the wide-scale administration of standardized tests. The inherent flaws and limitations of traditional standardized tests are numerous. Test content is usually the result of a negotiated compromise among a team of curriculum "experts." Test publishers ensure that chosen test objectives are matched to widely used textbooks, resulting in the narrowing of the content covered. Test emphasis on basic skills further constrains and limits the complexity of test content. Practical considerations limit content further through the use of multiple-choice format, a method that is less expensive and easier to administer than student-generated, open-ended responses.

In spite of these drawbacks, the public continues to give standardized test scores great weight. When these scores have serious consequences such as state financing, student placement, or town ranking, teachers find they must "teach to the test," a practice resulting in the corruption of instruction. Teaching to the test cheapens and undermines the authenticity of the scores as being accurate measures of what students

TIPS

How to Use This Chapter in Your Classroom

Performance-based learning and assessment can be easily introduced in a way that augments traditional instruction. Rather than having students do numerous examples in each chapter, try to devise an activity that allows them to do the things that people do in the real world when performing those very math tasks.

Example

When teaching a topic such as graphing, have students collect graphs from the newspaper and have them write about what the graph means for the article in which it was contained.

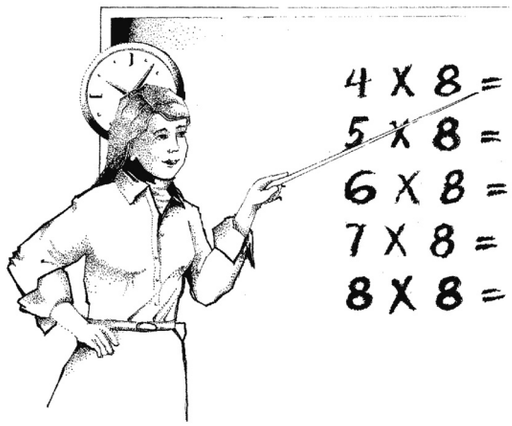
know. It also creates an unbalanced emphasis on tested areas, at the expense of untested areas. For example, teachers often find they must discard essay-type tests since those kinds of tests are inefficient for multiple-choice test preparation. The most efficient type of instruction for the multiple-choice format is instruction that consists of drill and practice on isolated, decontextualized skills (Popham, 2001).

In the society of 20 years ago, standardized tests seemed to serve as reasonable indicators of student learning. With the current knowledge of how the brain actually does process and acquire new learning, the incompatibility of standardized tests with deeper levels of understanding should cause educators, parents, and policy makers to reflect on the likelihood of such tests being inadequate and misleading as measures of achievement or accountability. While they are neither valid nor accurate indicators of actual learning, standardized tests are excellent indicators of fact memorization and test-taking skills.

However, the memorization of bits and pieces of knowledge cannot sufficiently prepare today's youth for the challenges of the twenty-first century. Valid tests must require more complex and challenging mental processes from students. The existence of more than one correct approach or response must be acknowledged and encouraged.

TRADITIONAL VERSUS BRAIN-FRIENDLY ASSESSMENTS

Assessment should be the central aspect of classroom practice that links curriculum, teaching, and learning. Unfortunately, however, assessment is primarily used by teachers to assign grades at the end of a unit of instruction and to differentiate the successful students from the unsuccessful. Teachers tend to rely heavily on written work involving the completion of imitative exercises and routine problems. This traditional practice stands in sharp contrast to the conception of assessment as reflected in the National Council of Teachers of Mathematics Standards document (NCTM, 2000). This book presents a vision of assessment that is ongoing and that is carried out in multiple ways: by listening to, observing, and talking with students; by asking students questions to help reveal their reasoning; by examining students' individual or group written and/or project work.



When conceived of and used in this constructive manner, assessment helps teachers gain better insight into their students' thinking and reasoning abilities. Assessment can also be a powerful tool for enabling teachers to monitor the effectiveness of their own teaching, judge the utility of the learning tasks, and consider where to go next in instruction.

Performance assessments will not work unless educators engage in performance-based classroom instruction as well. To achieve consistent

performance-based instruction, educators must use performance-based tasks combined with ongoing assessment:

assessment → feedback → instruction modification →
assessment → feedback . . .

IMPORTANCE OF PERFORMANCE ASSESSMENT

Traditional assessments such as multiple-choice and fill-in chapter/unit tests have not done an adequate job of profiling students with validity or accuracy. Rather, what is needed are assessments that

- more closely reflect the learning goals we have for students,
- communicate the right messages to students about what is being valued,
- align with current theories of instruction, and
- describe students rather than sort them out.

Performance assessment has come to the forefront due to the nature of the goals and standards various educational groups have set for students. If these new standards are to address the concepts of critical thinking, problem solving, communication, collaborative working, and lifelong learning, then a different, more innovative assessment process is needed for the task of evaluation.

Performance assessment is not a new or novel approach. Educators have always used day-to-day classroom observations of student progress for evaluation purposes. What is new, however, is the attempt to give this evaluation modality a more central role in large-scale assessments, and to make day-to-day evaluation more consistent and systematic. To achieve the goal of making these subjective assessments as objective, systematic, and, therefore, as credible as possible, educators must first be sure that the learning goals are clear. Once these goals have been established, the best assessment technique for each particular goal must be chosen. Performance assessment may or may not always be the best method; it depends on what is being assessed.

Current brain research and cognitive psychology suggest that learning occurs when learners construct their own knowledge and develop their own cognitive relationships between concepts and facts. Therefore, to become adept at thinking and reasoning, students need to practice solving real problems. Low-achieving students suffer most from a proficiency-driven curriculum. Because schools postpone the practice of higher-order thinking skills instruction until after basic, low-level skills have been mastered, these students are sentenced to dull drill and repetition indefinitely. They never seem to grasp the concepts underlying the drill.

Educators are aware that good instruction actively involves students in the learning process. In the past, having knowledge of large numbers of facts was valued by society; however, with information increasing today at exponential rates, students will be more likely to need the ability to access information and then apply that information to real-life situations. Throughout their lives, today's students will be faced with problems and situations that have no

clear-cut correct answers. They will need to analyze those situations and then apply their knowledge and skills to find acceptable solutions. The difficulty is that what students need to know and to be able to do can sometimes be very different from what is being taught in schools. As in the past, students still need to know facts, but the educational emphasis is now shifting.

Traditional assessment formats measure facts and skills in isolation. As the curriculum evolves to better reflect the skills that today's students will need to function effectively in the twenty-first century—skills such as critical thinking, problem solving, and teamwork—the methods of assessing learning must also change. If they do not change, assessment may very well get in the way of reform. If teachers teach to those higher-level cognitive skills, yet students continue to be tested on how well they have memorized facts, this obvious conflict of purpose confuses both students and teachers as to what skills society values.

Educators and educational researchers recommend changing achievement assessment to better reflect the current educational shift in emphasis, expectations, and standards. This evolving type of assessment, referred to as "alternative assessment," can include a wide variety of assessment formats, in which students create their own responses to questions rather than choose a response from a given list. Authentic activities involve complex behaviors not easily assessed by traditional paper-and-pencil tests, activities such as (1) the planning and execution of an experiment, (2) the construction of a graph, chart, or diagram, (3) the construction of a scientific or geometric model, or (4) the construction of a concept map (a diagram of the unit concepts [usually shown as circles] and the interrelationships between them [usually drawn as lines connecting two or more concepts]).

ALIGNMENT OF CURRICULUM AND ASSESSMENT

Once the desired educational priorities are established, the focus can then be shifted to the attainment of those priorities. With the goals and instruction practices in place, it is the assessment process that provides a clear understanding as to whether those desired goals have been achieved. If such assessment is not in alignment with the curriculum, then there is no validity to the results achieved, and students get a conflicting message as to what is valued. The alignment of curriculum and assessment is based on three major decisions: (1) establishing the goals or objectives, (2) the method by which those goals or objectives are to be achieved, and (3) a system for monitoring and assessing the level of goal achievement resulting from the instruction.

Sound educational practice dictates that it is the goals of education that must drive the system. New educational goals will form the basis for the everyday skills needed by the citizens of this millennium. These new educational goals include the development of the

- love of learning,
- knowledge of what to do when problem answers are not readily apparent,
- cooperation and collaboration,

- precise communication in a variety of modes,
- appreciation for different value systems,
- problem solving encouraging creativity and ingenuity,
- ability to resolve ambiguous and contradictory situations,
- organization and evaluation of an overabundance of technologically produced information,
- pride in a product of quality,
- high self-esteem, and
- personal commitment to larger organizational and global values.

Assessment methods need to change so as to be consistent with these new goals. Norm-referenced (compared to a set of predetermined standards) standardized test scores result in a static number that reflects the achievement and performance of isolated skills at a specific moment in time. Thinking, however, is dynamic in that we learn from experience, react emotionally to situations, become empowered by problem solving, and are energized by the act of discovery. Criterion-referenced tests, unlike norm-referenced, evaluate student results with regard to a fixed set of predetermined criteria rather than a comparison of students to their peers. While educators, policy makers, and the public at large are questioning the value of standardized testing instruments, states are experimenting with and advocating innovative assessment methods such as free-response and open-ended type questions, portfolios, performances, and exhibitions (see below).

These methods are more "authentic" than traditional testing procedures in that

- they are not neat, contrived little packages, but rather "messy" to solve, having no clear-cut, "single-right-answer" solutions, and are more in keeping with real-life experiences;
- they allow teachers more leeway in diagnosing students' abilities with greater accuracy through the observation of student habits and repertoires rather than just recall;
- they take place during instruction rather than after instruction (as with an end-of-unit test), thereby providing more immediate feedback for teachers to use in the evaluation and modification of the instruction; and
- they provide timely feedback to the students who through these examples learn from the assessment process itself, and who ultimately become the evaluators of their own work.

Educators have long relied on a limited range of assessment measures, primarily traditional pencil-and-paper tests. Assessing goals in the restructured school will require an expansion of our repertoire of assessment techniques. Some of the more authentic assessment techniques that provide a more multidimensional perspective of student growth and progress are

1. direct observation of student performance in problem-solving situations,
2. portfolios of student work developed over time,

3. extended projects,
4. logs or journals,
5. writing samples,
6. performance assessment using a set of agreed-upon criteria (a rubric),
7. anecdotal records, and
8. electronic portfolios (using technology to assist in the collection and recording of student growth over time).

These authentic assessment techniques provide much greater insight into student progress and growth than do traditional paper-and-pencil tests.

ASSESSMENT AS CONTINUOUS MONITORING

Using the recent knowledge gained from brain research and cognitive psychology (how learning occurs), the teacher must continually monitor each student to meet the needs of that student. An instructional paradigm such as this is guided by student questions; integrates multiple cultural, racial, and gender values; and is constructivist in that it builds on student biological and experiential prior knowledge. It also supports active experiential learning, fosters collaboration, and takes into account individual learning styles and stages of cognitive development.

Similarly, the role of assessment in the new paradigm must also change. Rather than rewarding only correct responses, assessment must also inquire as to the reasons for obtaining incorrect responses (which, when viewed from the student's perspective, may not be incorrect at all). The role shift emphasizes different kinds of assessment for different purposes, and multiple forms of assessment for determining student learning. Assessment is geared to improving instruction, to stimulating inquiry and personal growth in students, and to fostering cooperative learning. In other words, it must assess what society values; in the educational arena, that is student learning.

Assessment provides the information to power instructional decision making. It is the part of the feedback loop that helps to monitor student progress and make any needed adjustments in instruction. To make such adjustments, educators must pay attention to

- the kinds of student outcomes that monitor progress and emphasize skills such as collaboration, critical thinking, and student ownership of learning;
- the need for more performance-based assessments that will monitor progress on these new outcomes; and
- the need for more systematic methods for the gathering and organizing of classroom data and observations.

The integration of assessment and instruction provides the best approach for the continual monitoring of student learning. In its ideal form, this integration is

so complete that the lines between assessment and instruction fade. The student is completely unaware of being assessed, of instruction being modified on the spot, or of further cycles of assessment/instruction/modification of instruction/reassessment and so on. Assessment becomes a continuous activity in the instruction process, designed to create an optimal learning situation for students. It results in an ongoing evaluation and adjustment dynamic on the part of the teacher. To be truly effective, instruction and assessment must be thoroughly integrated. If they aren't, those students who have traditionally performed poorly in the old educational paradigm ("at-risk" students) will be lost in the new one as well.

The NCTM "standards-based" math curriculum materials advocate assessments that

- are embedded within instructional materials,
- use a variety of methods to assess student progress,
- emphasize teacher observation and teacher judgment, and
- provide methods for getting at the reasons behind students' answers.

Viewed in this manner, good assessment becomes more than just an exercise in monitoring at the end of a unit of instruction. It becomes the essential ingredient that forces us to be more clear about what it is we wish to accomplish with our students, and simultaneously, a tool for helping students attain those goals.

ASSESSMENT AS A TOOL FOR LEARNING

State, city, and classroom assessments all influence students directly, for better or worse. Assessment is neither just a neutral collection of information, nor is it merely a way of influencing future instruction by teachers. If designed properly, assessment becomes a way of directly influencing students in a positive manner. Students will learn from doing an assessment activity, since the performance of that activity is in itself an instructional experience. This firsthand experience of the assessment process enables students to develop the necessary skills of self-evaluation.

Once aligned, curriculum and assessment tools help students to both learn and be assessed using brain-compatible ideology. The curriculum tools needed for such a shift in framework are based upon the performance aspect of a learning task, that particular element of the educational equation now requiring a distinctly different methodology for its planning and development.

Grades K–2 Units

Because young children develop a disposition for mathematics from their early experiences, opportunities for learning should be positive and supportive. Children must learn to trust their own abilities to make sense of mathematics. Mathematical foundations are laid as playmates create streets and buildings in the sand or make playhouses with empty boxes. Mathematical

> *ideas grow as children count steps across the room or sort collections of rocks and other treasures. . . .*
> *. . . Most students enter school confident in their own abilities, and they are curious and eager to learn more about numbers and mathematical objects. They make sense of the world by reasoning and problem solving, and teachers must recognize that young students can think in sophisticated ways. Young students are active, resourceful individuals who construct, modify, and integrate ideas by interacting with the physical world and with peers and adults.*
>
> —NCTM (2000, pp. 74–75)

Both of the following units are good examples of performance-based instruction and assessment. They each provide numerous opportunities for students to demonstrate their understanding of new concepts through performances that involve application of principles learned in the units. In addition, these units can be revised for use in higher grades by increasing their complexity. For example, "Sweet Finance" can be made more complex by increasing the number of items carried in the "store," adding the concept of taxing purchases, or giving the students more ways to "earn" their money.

"Shapes, Patterns, and Tessellations" can be made more complex by increasing the number and variety of shapes used in the tessellations, as well as having students write rationales for their design plans.

Sweet Finance

Primary Level

In this unit, students set up and run an ice cream/candy store. They are each responsible for researching the prices of two items that are on the store supply list. They are given a set amount of money each week, and they will be able to earn more by working in the store. Student responsibility encompasses (1) tracking money spent each week and (2) accounting for purchased items.

SWEET FINANCE PROJECT ORGANIZER

CURRICULUM AREAS: Mathematics, Language Arts, Social Studies

PROJECT TITLE: Sweet Finance

GRADE LEVEL: 2–3

PROJECT LENGTH: 3–4 weeks

RESOURCES/MATERIALS: Store supply list, playdough for ice cream and candy, pretend money, cash register

STANDARDS ADDRESSED

MATHEMATICS (NCTM)	LANGUAGE ARTS (NCTE)	SOCIAL STUDIES (NCSS)
1. Number and operations Students compute fluently and make reasonable estimations	4. Adjust their use of spoken, written, and visual language for purpose and audience 7. Conduct research, gather and evaluate information 8. Use a variety of technological information resources 12. Use spoken, written, and visual language to accomplish their purpose	7. Production, distribution, and consumption of goods and services 9. Global connections dealing with economics

PROJECT DESCRIPTION

Students will set up and run an ice cream/candy store. Each student will be responsible for researching the prices of two items that are on the store supply list. Each student will be given a set amount of money each week, and they will be able to earn more by working in the store. Students will be responsible for tracking money they have spent each week and accounting for exactly what items were purchased. Students will have to use estimating skills to decide whether they have enough to purchase what they want on a given day. They will also need to budget their money so it lasts the week.

PROJECT OBJECTIVES

COMPREHENSION OF CONCEPTS	SKILL AND PROCESS DEVELOPMENT
• Increase students' financial awareness • Teach students to budget finances	• Addition and subtraction using money • Estimation skills • Working collaboratively • Oral communication

PRODUCTS AND/OR PERFORMANCES

GROUP PRODUCTS	INDIVIDUAL PRODUCTS	EXTENSIONS
Team will collaborate to set up and run the "grocery" store	Students will keep a running tally of the items and the money spent. They will also have to write a paragraph at the conclusion of the mock store, discussing what they have learned.	With the help of a family member, students must track the food bought and money spent in one week and orally share their findings with the class.

CRITERIA FOR PRODUCT/PERFORMANCE EVALUATION

GROUP PRODUCTS	INDIVIDUAL PRODUCTS	EXTENSIONS
Store organization • pricing • inventory • managing	• Performance task assessment of students' spending, budgeting, and estimating skills • Research and accuracy of pricing for two assigned store supplies • Written paragraph on what they learned	• Presentation and data collection skills used to track family food spending

SWEET FINANCE PROJECT UNIT MAP

UNIT CONTENT	LESSON 1 OBJECTIVES	LESSON 1 ACTIVITIES
CURRICULUM AREAS: Mathematics, Language Arts, Social Studies GRADE LEVEL: 2–3 TOPIC: Money and Finance GOALS: Increase student awareness of living costs RATIONALE: Children need to understand money and economics for success OBJECTIVES: • Addition and subtraction • Estimation • Collaboration • Oral communication	At the end of the lesson students will be able to: • Compare and contrast coins • Match coin and value	• Introduce students to pennies, dimes, nickels, and quarters • Brainstorm about coins with students • Examine coins with magnifying glass • Create a Venn diagram
	LESSON 2 OBJECTIVES	**LESSON 2 ACTIVITIES**
	At the end of the lesson students will be able to: • Differentiate between various coins • Solve addition problems using coin values	• In groups, students write descriptive poems • Illustrate each poem with coin stamps • Students add coin values at the end of the book
	LESSON 3 OBJECTIVES	**LESSON 3 ACTIVITIES**
	At the end of the lesson students will be able to: • Solve problems by making change	• Read *Market!* by Ted Lewin (New York: Lothrop, Lee & Shepard Books) • Review coin combinations to $1.00 • Explain the multiple meanings of the word *change* • Cooperative groups label items with prices • Students buy, sell, and make change
	LESSON 4 OBJECTIVES	**LESSON 4 ACTIVITIES**
	At the end of the lesson students will be able to: • Solve addition and subtraction problems	• Review and discuss coins • The class discusses prior knowledge of coins • Teacher demonstrates adding and subtracting with coins • Students create their own bank used for game • Play money used in the bank
	LESSON 5 OBJECTIVES	**LESSON 5 ACTIVITIES**
	At the end of the lesson students will be able to: • Demonstrate understanding of estimation	• Read *A Chair for My Mother* by Vera Williams (New York: Greenwillow Books) • Discussion of questions and answers related to the story • Make estimate of pennies in the jar • Teacher monitors student estimates
	LESSON 6 OBJECTIVES	**LESSON 6 ACTIVITIES**
	At the end of the lesson students will be able to: • Demonstrate data recording • Demonstrate addition and subtraction skills	• Students will purchase and sell candy and cookies • Students will record group sales and individual purchases

SWEET FINANCE PROJECT RUBRIC

CRITERIA EVALUATED	**NOVICE** BEGINNING	**BASIC** DEVELOPING	**PROFICIENT** ACCOMPLISHED	**ADVANCED** EXEMPLARY
GROUP COOPERATION	• Cooperates at times • Rarely contributes • Shows little respect for others' ideas	• Usually works well with peers • Participates in group work at least half the time • Listens to others' ideas most of the time	• Works well with group • Listens to ideas of others	• Contribution to collaboration creates synergy • Each member listens to and respects ideas of others
ACTIVE PARTICIPATION	• Limited participation in group as well as individual activities	• Passive in group activities but participates in individual tasks	• Active participant in group and individual tasks	• Takes a leadership role in group activities • Approaches individual tasks with enthusiasm and a high level of creativity
ORGANIZATION OF ICE CREAM SHOP	• No record of inventory • No item prices • Does not sort "items" into categories • No attempt is made for inventory to be visually appealing	• Keeps records of inventory with some degree of accuracy • Prices some of items • Displays "items" but not in categories	• Keeps accurate records of inventory • Prices all items using monetary symbols • Displays and sorts all "items" into appropriate categories	• Keeps highly accurate records of inventory • Accurately prices all items using correct monetary symbols • Displays and sorts all "ice cream and candy items" into visually appealing and appropriate categories
WRITTEN PARAGRAPH	• Choppy and confusing • Unfocused • No examples of new learning	• Weak and unclear • Poorly focused • Gives only 1–2 examples of new learning	• Concise and easily understood • Focuses on unit throughout • Gives 3–4 examples of new learning	• Highly organized • Focuses on unit and relates unit to personal experiences • Gives 4 or more examples of new learning and making that learning relevant
COIN RECOGNITION, ESTIMATING AND BUDGETING OF MONEY	• Little awareness of coins or coin values • Weak estimation skills • Does not keep any account of money management	• Demonstrates little awareness of coins and coin values • Demonstrates little understanding of estimating skills • Does not keep an accurate account of money or management	• Demonstrates an awareness of coins and coin values • Demonstrates an understanding of estimating skills • Keeps an accurate account of money and management	• Demonstrates advanced awareness of coins and coin values • Demonstrates refined estimation skills • Complex and intricate account of money management

Shapes, Patterns, and Tessellations

Primary Level

This primary mathematics unit, "Shapes, Patterns, and Tessellations," studies geometric shapes and their occurrence in the world outside the classroom. A set of primary objectives for geometry is covered as well as introductory geometric vocabulary and terms.

In tasks 1 and 2, the students learn about geometric shapes and their tessellating qualities (the ability of geometric shapes to form a pattern design in which all the shapes touch, yet there are no empty spaces between the touching shapes). The students then progress to task 3 where they create original multishape tessellations on their own.

The contextual learning in this unit is designed around the students' creative interests. All of the learning is structured around the recognition and knowledge of geometric shapes. The students work together in pairs. Learning and processing can take place outside the classroom as well as inside. Also, students have the opportunity to monitor their own learning as well as maximize that learning. Metacognitive opportunities are also encouraged through the use of self-evaluation (see Figure 1.4, below).

Shapes, Patterns, and Tessellations

Objectives

- To encourage the exploration of the relationships between and among basic geometric shapes
- To encourage pattern recognition and creation through the use of simple geometric shapes
- To encourage the design and formation of individual, unique geometric patterns

Materials

Pattern blocks, regular and colored pencils, paper

Vocabulary

square: a shape with four equal sides and each side at right angles

triangle: a three-sided shape

tessellate: shapes tessellate and form a tessellation design when all of the shapes in the design touch on all the sides, and there are no empty spaces between the shapes

Task 1

The teacher introduces the task with a discussion of what tessellations are, and where they can be found in the real world, for example, bathroom floors, kitchen walls and floors, ceiling tiles.

The students are then encouraged to work in pairs to create their own tessellation designs with the pattern blocks. Students will need guidance and frequent reminders that there cannot be any empty spaces if the shapes are to tessellate.

Task 2

Using two different kinds of pattern blocks, the teacher demonstrates how to trace (outline) the pattern block's shape. The students then practice tracing one of the shapes on their own. Once familiar with the tracing technique, the students can then design tessellation patterns of their own using a single geometric shape that tessellates (see Figures 1.1 and 1.2).

Squares

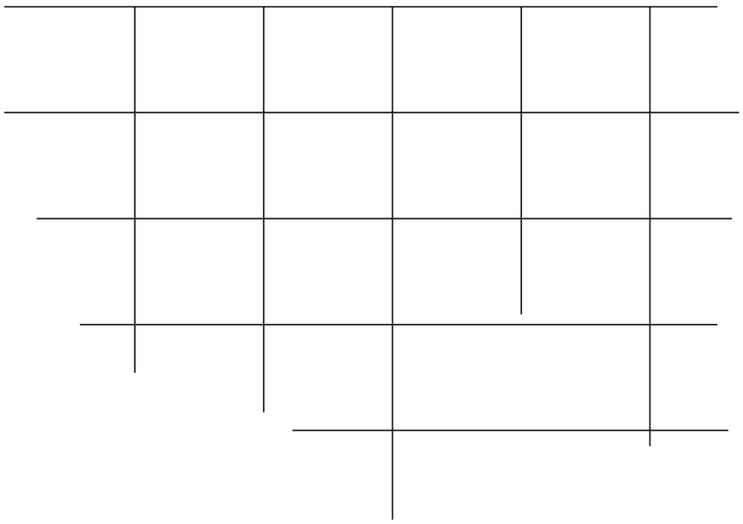


Figure 1.1

Triangles

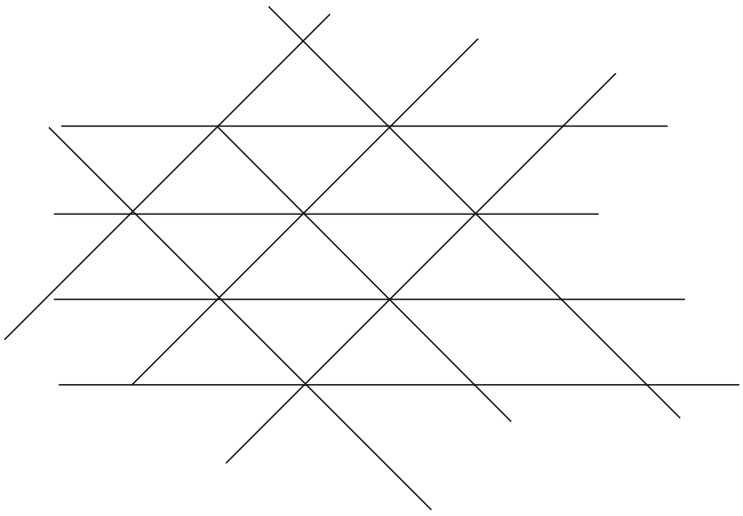


Figure 1.2

Task 3

In the second, more advanced pattern design, the teacher demonstrates tessellation development (the building of pattern combinations). The students then experiment on their own with two shapes that tessellate (i.e., the triangle and square). After the tessellation drawings have been completed, encourage the students to color their designs in intricate ways (see Figure 1.3).

An example of a primary-level student self-assessment is shown in Figure 1.4.

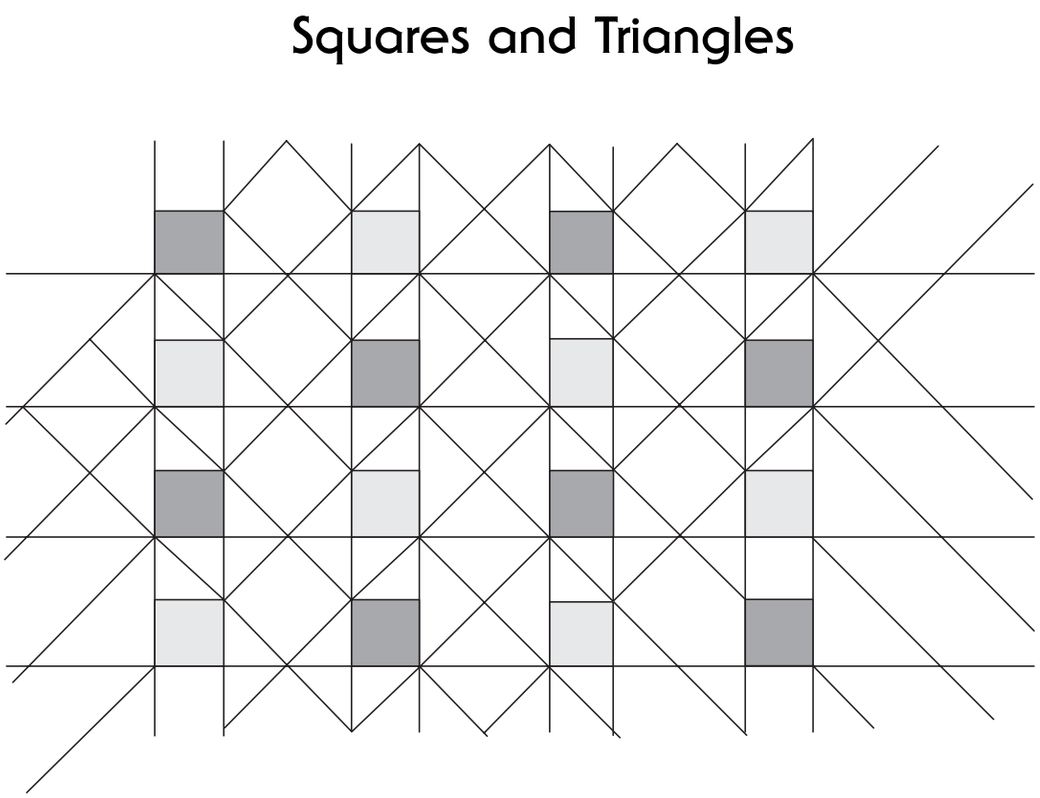


Figure 1.3

Geometry Tessellation Self-Assessment

Primary Grades

1. Did I follow the teacher's directions?

2. Do all of my shapes fit together?

3. Does my tessellation have any empty spaces?

4. Do all of my shapes form a pattern?

5. Can I make a tessellation design by myself now?

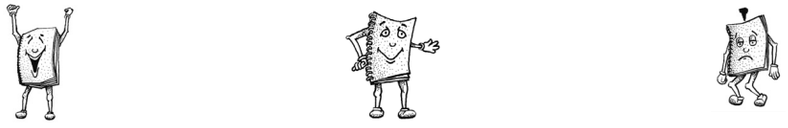


Figure 1.4